FISHER-ROSEMOUNT

RS3™

Service Manual

Volume 1

August 1998
U.S. Manual PN: 10P56980201
A-4 Size Manual PN: 10P56980211

10P56985101
10P56985111

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Components of the RS3 distributed process control system may be protected by U.S. patent Nos. 4,243,931; 4,370,257; 4,581,734. Other Patents Pending.

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Service Manual

About This Manual

The Service Manual provides information on service, calibration, maintenance, and troubleshooting RS3 hardware. The Service Manual provides a brief idea of the function of each device, along with details of cabling, LEDs, jumpers, and fuses. Installation planning data is covered in the *Site Preparation and Installation Manua*l (SP).

Devices are arranged in functional groups within the Service Manual. To quickly find specific information, use the Index. You can look up a device by name, part number, or the legend printed on the silkscreen. An abstract of the service data appears in the *Service Quick Reference Guide* (SQ), which is small enough to be readily portable.

Factory Repair Items

Parts of devices that are listed as replacement parts are permitted to be replaced in the field with the stated replacement part as designated in the user documentation. ***Any part of a device that is not listed as a replacement part is not to be replaced in the field, but must be returned to the factory for repair.***

Changes for This Release

- Numerous corrections and minor revisions have been made throughout the manual.
- Information on the RS3 Millennium Package (RMP), the System Power Supply Unit, and the MPC5 Controller Processor with 4 Meg NV Memory has been incorporated into the manual. Information of the MAI16 and Loop Power Module has also been incorporated.

Revision Level for This Manual

RS3 Service Manual releases are independent of software releases. New equipment and information is added to the Service Manual in each release, and older material is updated. You should always use the latest version of the Service Manual.

For This Software Version:	Refer to This Document:		
	Title	Date	Part Number
All	Service Manual	August 1999	10P569802x1

NOTE: The “x” in the part number is 0 for US size (8-1/2 x 11 inches) or 1 for A-4 size.

References to Other Manuals

References to other RS3 user manuals list the manual, chapter, and sometimes the section, as shown below.

Sample Entries:

For ..., see CC: 3.

Manual Title Chapter

For ..., see CC: 1-1.

Manual Title Chapter-Section

Abbreviations of Manual Titles

- **AL** = Alarm Messages
- **BA** = ABC Batch
- **CB** = ControlBlock Configuration
- **CC** = Console Configuration
- **DT** = Disk and Tape Functions
- **IO** = I/O Block Configuration
- **OP** = Operator’s Guide
- **OV** = System Overview and Glossary
- **PW** = PeerWay Interfaces
- **RB** = Rosemount Basic Language
- **RI** = RNI Installation Guide
- **RR** = RNI Release Notes
- **RP** = RNI Programmer’s Reference Manual
- **SP** = Site Preparation and Installation
- **SV** = Service

Reference Documents

Prerequisite Documents

You should be familiar with the information in the following documents before using this manual:

NOTE: The “x” in the part number is 0 for US size (8-1/2 x 11 inches) and 1 to 9 for A-4 size.

System Overview Manual and Glossary	1984-2640-21x0
Software Release Notes, Performance Series 1	10P56870106

Related Documents

You may find the following documents helpful when using this manual:

ABC Batch Software Manual	1984-2654-21x0
Alarm Messages Manual	1984-2657-19x1
ABC Batch Quick Reference Guide	1984-2818-1103
Configuration Quick Reference Guide	1984-2812-0808
Console Configuration Manual	1984-2643-21x0
ControlBlock Configuration Manual	1984-2646-21x0
I/O Block Configuration Manual	1984-2645-21x0
Operator’s Guide	1984-2647-19x1
PeerWay Interfaces Manual	1984-2650-21x0
Rosemount Basic Language Manual	1984-2653-21x0
RNI Programmer’s Reference Manual	1984-3356-03x1
RNI Installation Guide	1984-3357-02x5
RNI Release Notes	10P574830x1
Site Preparation and Installation Manual	10P569902x1
Service Quick Reference Guide	10P57000201
Software Discrepancies for Performance Series 1	10P56870304
Software Loading and Upgrade Procedure, Including Batch, Performance Series 1	10P56870206
User Manual Master Index	1984-2641-21x0

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Service Manual

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Section 1:
AC Input

This section describes the AC power distribution system.

AC Entrance Panel

The AC Entrance Panel (10P5662000x and 1984-0303-000x) supplies AC power to the DC power supplies and distributes AC power to the fans in the cabinets. The AC entrance panel is designed as a single or dual feed entrance to use with one or two AC input power sources.

NOTE: The System Power Supply Unit does not require an AC entrance panel.

Table 1.1.1 shows the AC input wire connections. Figure 1.1.1 shows a functional diagram for the AC distribution system through the AC entrance panel.

Table 1.1.1. AC Input Wiring

Terminal	115 VAC Wiring	230 VAC Wiring
L1	Hot	Line 1
L2/N	Neutral	Line 2
⏚	Ground	Ground

CAUTION

If the caution symbol shown on the left is present on the cabinet door (near the handle), then multiple mains supply circuits are located within the cabinet. Disconnect all mains supplies prior to servicing.

CAUTION

Use supply wires suitable for 115°C above surrounding ambient if input current exceeds 20 amperes.

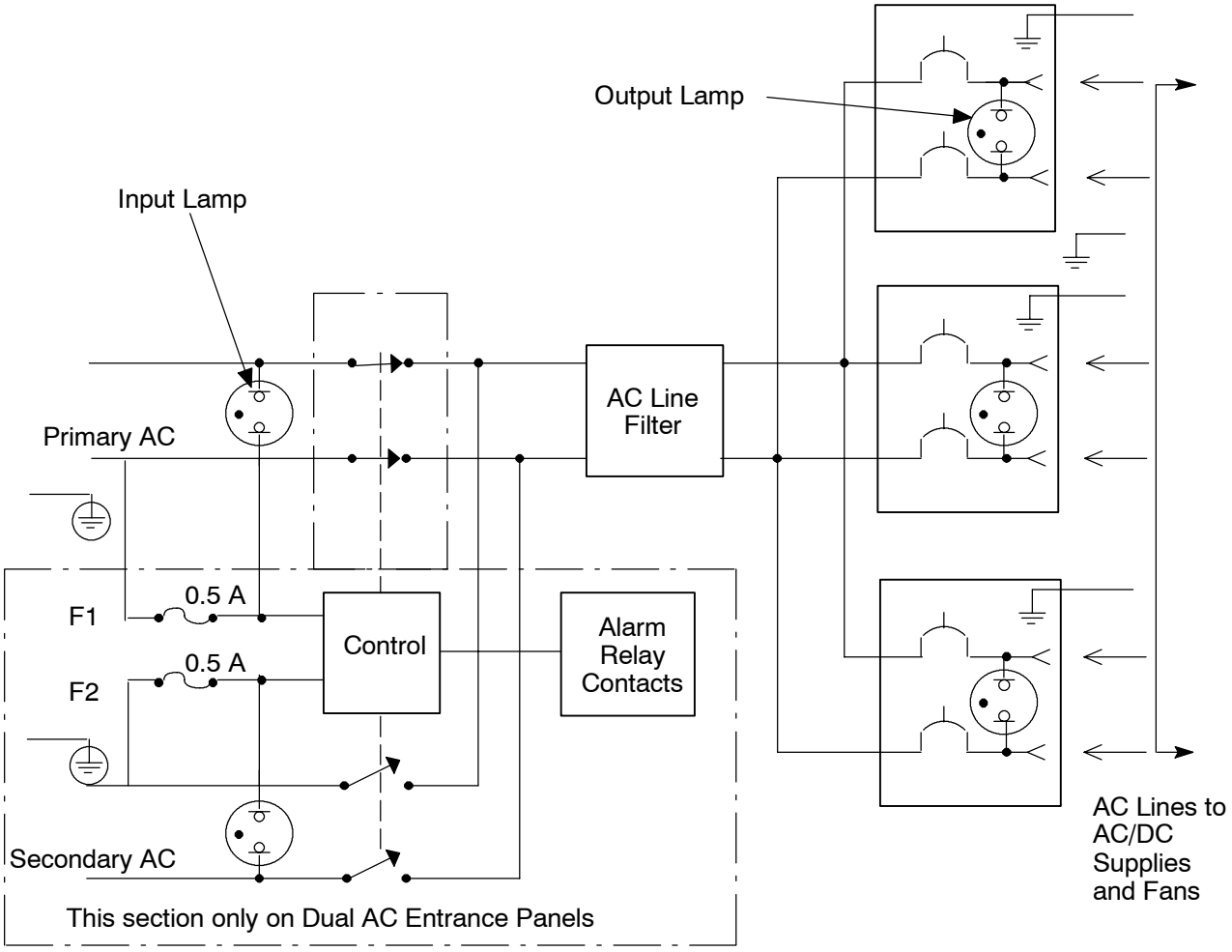


Figure 1.1.1. AC Distribution System

Single Feed AC Entrance Panel

Power distribution for a single AC input panel includes an internal filter to reduce the incoming AC line noise. Three output breakers protect up to three AC/DC power supplies. The output breakers can also be used for AC cooling fans.

Figure 1.1.2 shows a Single Feed AC Entrance Panel. The lamp labeled “INPUT” indicates AC input to the system. The lamps labeled “OUTPUT” indicate AC out of each of the three circuit breakers (10-amp for 230 VAC and 15-amp for 115 VAC).

WARNING

For personal safety, use a circuit breaker lockout device to ensure that an opened breaker is not accidentally closed while you are working on the line.

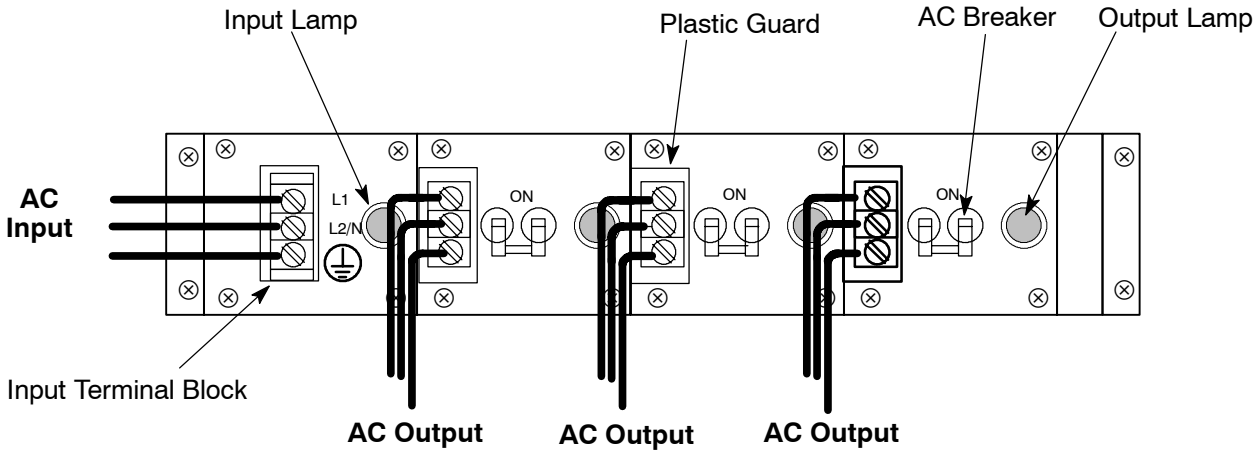


Figure 1.1.2. Single Feed AC Entrance Panel

Dual Feed AC Entrance Panel

A Dual Feed AC Entrance Panel accepts AC from two independent sources. If the primary (upper) AC line drops out, the secondary (lower) AC line automatically switches in within 500 milliseconds. The 500 millisecond delay prevents arcing during switching if the two AC lines are out of phase. If primary AC power is restored, the relay switches back automatically from the secondary AC source to the primary AC source. Alarm output relay contacts indicate which AC line is being used. Note that this provides dual power sources but no duplication of circuit breakers, etc. Figure 1.1.3 shows a dual feed AC entrance panel.

If fuse F1 or F2 is blown the associated “INPUT” lamp goes out, which indicates that power cannot be switched over from one AC line to the other.

WARNING

Dangerous AC voltage may be present even if the “AC IN” indicator is not lit. If the input fuse is blown, AC may still be present at the input terminal block.

The lamps labeled “OUTPUT” indicate AC out of each of the three circuit breakers (10-amp for 230 VAC and 15-amp for 115 VAC).

WARNING

For personal safety, use a circuit breaker lockout device to ensure that an opened breaker is not accidentally closed while you working on the line.

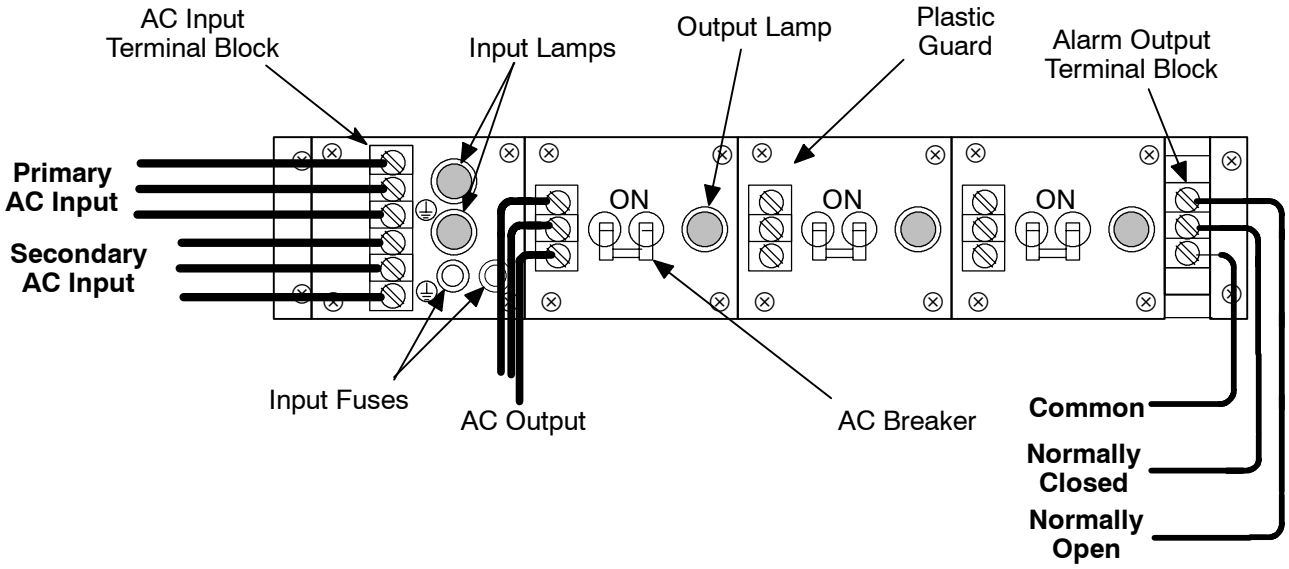


Figure 1.1.3. Dual Feed AC Entrance Panel

Dual Feed AC Entrance Panel Fuses

The state of the Alarm Output is determined by which power input is being applied. The state of the Alarm Output under primary or secondary power is:

Power	Normally Open Contacts	Normally Closed Contacts
Primary	closed	open
Secondary	open	closed

Table 1.1.2 gives fuse data for the Dual Feed AC Entrance Panel.

Table 1.1.2. Dual Feed AC Entrance Panel Fuses

Fuse	FRSI Part No.	Bussman Part No.	Littelfuse Part No.	Characteristics
F1 F2	C09140-0017	MDQ 1/2	- -	0.5 A 250 V Slow Blow

Section 2:
Power Supplies

This section gives the hardware descriptions and functional diagrams for these power supplies:

- AC/DC Power Supply (With Battery Backup)
- AC/DC Power Supply (Without Battery Backup)
- Multitube Command Console (MTCC) Remote Power Supply
- OI Remote Power Supply
- DC/DC Power Supply
- AC/DC Unregulated Power Supply
- Remote I/O Power Supply
- Remote Power Supply
- Distribution Blocks

NOTE: Information on System Power Supply Units is in Section 3.

AC/DC Power Supply (With Battery Backup)

The AC/DC Power Supply (with battery backup) (10P5658000x, 1984-2298-000x and 1984-0298-000x) provide 30 volts DC to the DC bus. AC/DC power supplies are rack mounted in the console cabinet. The -2298 supply is an internal redesign of the -0298 supply; they are completely interchangeable.

CAUTION

The power supply unit is heavy, approximately 32 kg (70 lb).

CAUTION

The top surface of the power supply may be hot.

Figure 1.2.1 shows the power supply front panel. Table 1.2.1 gives parts replacement data.

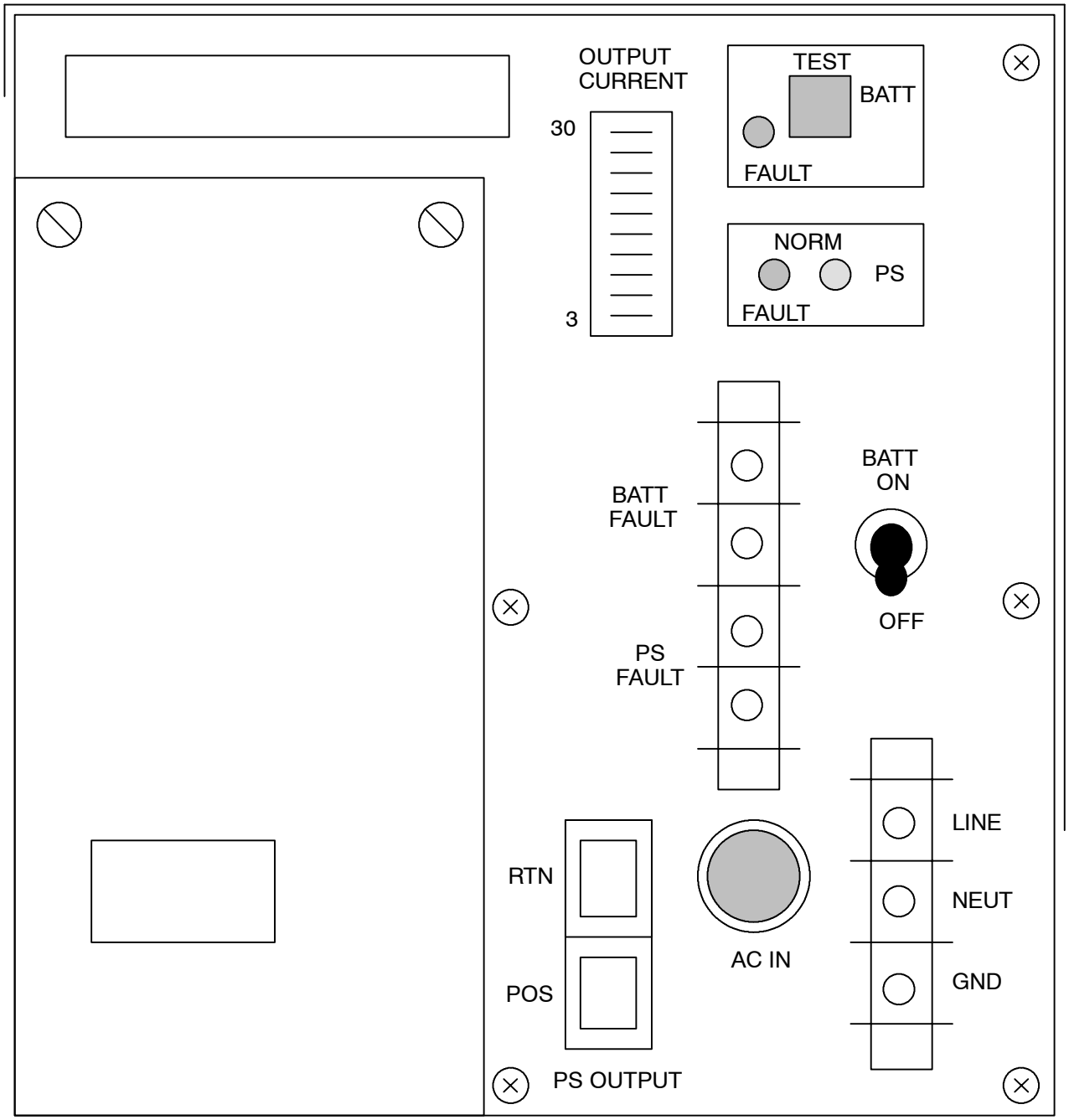


Figure 1.2.1. AC/DC Power Supply (With Battery Backup) Front Panel

CAUTION

Use only the following rechargeable sealed lead-acid batteries in the power supply. Always replace batteries in pairs. Do not mix batteries from different manufacturers.

- **Portalac PE 7.0-12R**
- **Panasonic LCR 12V6.5BP**

Table 1.2.1. AC/DC Power Supply (With Battery Backup) Parts Replacement

Part No.	Replaces	Comment
10P5658000x	1984-0298-000x 1984-2298-000x 1984-0390-000x	The 10P5658000x supply is CE-compliant
1984-2298-000x	1984-0298-000x	Supplies are fully interchangeable with same voltage and frequency
1984-0298-000x	1984-2298-000x	Supplies are fully interchangeable with same voltage and frequency
1984-2298-000x or 1984-0298-000x	1984-0390-000x	Either supply may replace a -0390 AC/DC Power Supply (Without Battery Backup) but the BATT switch must be turned OFF. **NOTE:** The PS FAULT alarm jumper (HD1) must be set to 2-3 because the -0390 contacts are Normally Closed (N.C.).

Figure 1.2.2 shows the functional diagram. The AC/DC power supply uses a ferroresonant core transformer for partial regulation. The primary and secondary of the transformer have selectable taps for 50 or 60 Hz line frequency. The primary also has taps for 115 or 220 volts AC input. The third winding on the primary side is isolated and has a parallel capacitor. This provides transformer output voltage regulation by providing extra voltage to the circuit from the power stored in the resonant circuit. The third winding also inherently limits current.

NOTE: Because the transformer is self-regulating, no other power conditioning should be necessary. Do not use an isolation transformer, voltage regulating power source, or uninterruptible power supply with a ferroresonant transformer as its output device unless it is rated at least 3 kVA for each standard AC/DC power supply it powers. Use of a smaller ferroresonant transformer can result in oscillations.

An optional Battery Charger card in the power supply slowly charges the backup batteries, protects against momentary AC voltage drops, and contains contacts for external alarms if the output voltage drops below 26 volts DC. The Battery Charger card and batteries are not required for DC output from the power supply.

A 10 segment LED display shows the current output of the power supply in 3-amp increments.

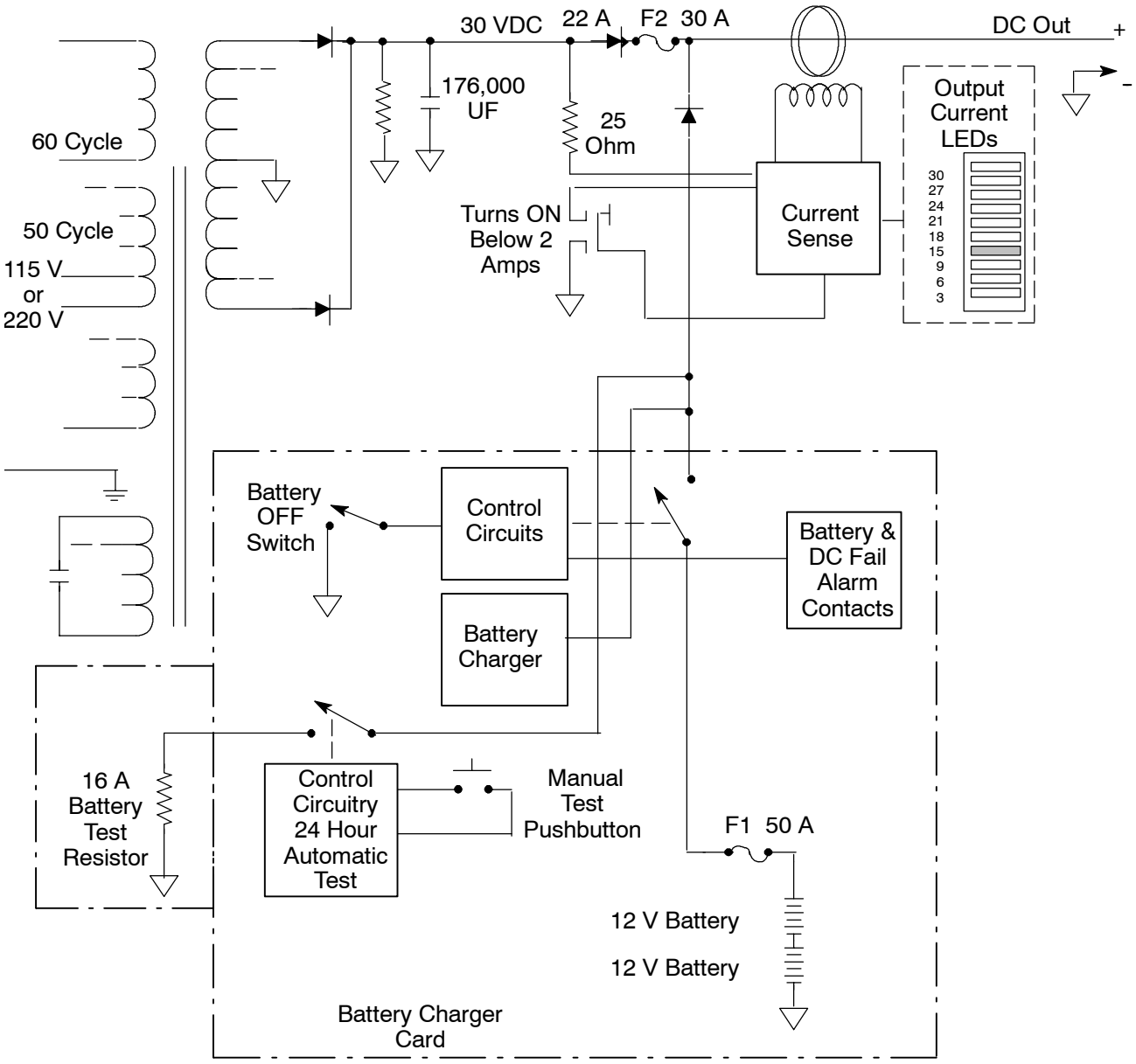


Figure 1.2.2. AC/DC Power Supply (With Battery Backup) Functional Diagram

AC/DC Power Supply (With Battery Backup) Alarm Contacts

The front panel provides two sets of terminals for battery fault and power supply fault alarm contacts. The cards are shipped with the contacts set to be normally open (N.O.). They may be changed to normally closed (N.C.) by changing jumper positions on the Battery Charger Card (1984-1283-000x). The appropriate contact will be closed (or opened) if the red BATT FAULT or PS FAULT LED is lighted. The supply will continue delivering power while the alarm condition is present. Figure 1.2.3 shows the alarm contacts.

The alarm contacts are rated for switching a resistive load:

- Maximum switching voltage: 100 VDC
- Maximum switching current: 250 mA
- Maximum current: 500 mA

AC/DC Power Supply (With Battery Backup) LEDs and Controls

The AC/DC power supply has power indicators and controls on the front panel. Figure 1.2.3 shows the location of the LEDs and controls. Table 1.2.3 shows the significance of each.

CAUTION

Under certain failure conditions, 30VDC can be present even though both LED indicators are off.

Check all AC/DC power supplies for both red LED fault indications and equal output current indication. All the supplies on the same DC distribution system should show approximately the same current flow indications within 3 to 6 amps (1 to 2 segments on the LED indicator). Check each DC distribution system individually.

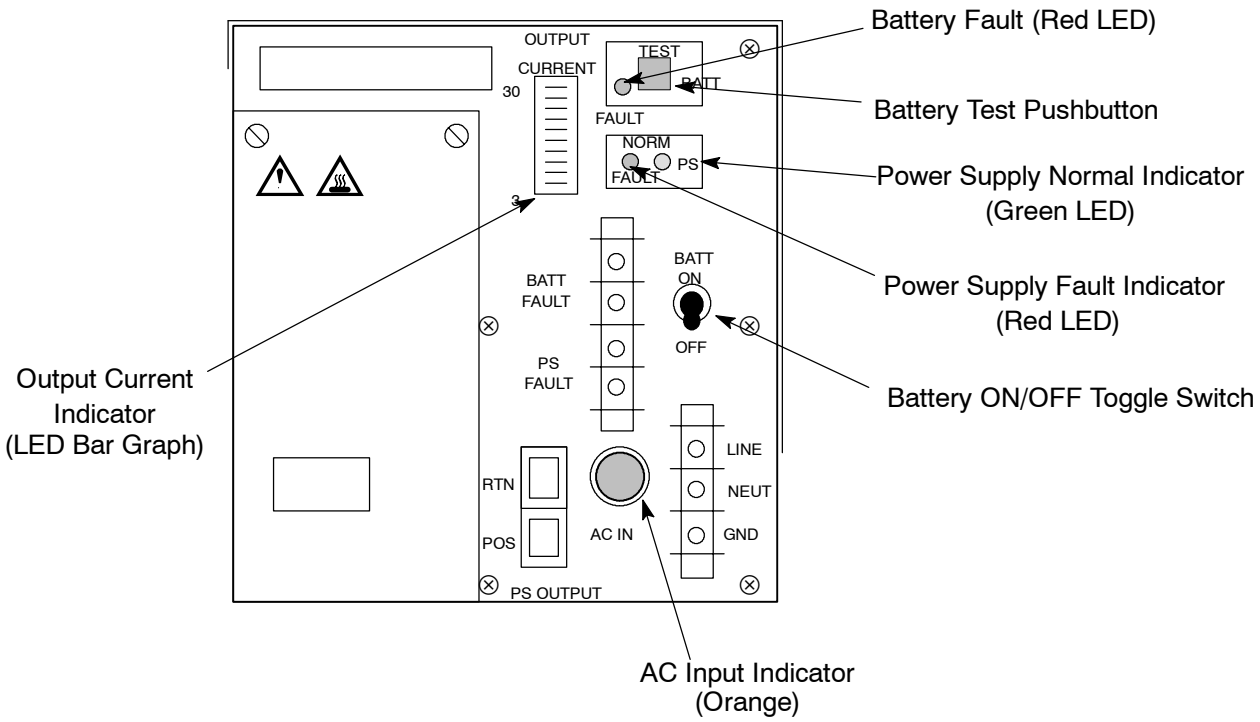


Figure 1.2.3. Power Supply (With Battery Backup) Panel Features

Table 1.2.2. Power Supply (With Battery Backup) Indicators and Controls

Item	Function
BATT ON/OFF Toggle Switch	Removes the battery backup circuit from the system when in OFF position.
BATT TEST Pushbutton	The Battery Test Pushbutton is used to manually enable the 16 amp, 5 second battery test. If battery voltage falls below 20 V during the test, the BATT FAULT LED lights and the battery alarm activates. **NOTE:** The battery cannot be tested until the system has been running for at least five minutes or until five minutes after the last battery test.
AC IN Indicator (Orange)	Indicates that AC input is present.
OUTPUT CURRENT (Bar Graph LED) (Red)	This is a series of LEDs indicating the relative current being delivered to the DC distribution system by the AC/DC power supply. It indicates the load share provided by the power supply with a readout in 3 amp intervals. Power supplies should be within 1 to 2 LEDs of the others on the DC distribution system for proper load sharing.
PS FAULT LED (DS1) (Red)	The 30 volt DC output dropped below 26 volts. The power supply alarm is actuated when this LED is on.
PS NORM LED (DS2) (Green)	The DC output voltage and battery status (if the battery is used with the header jumper enabled) is in normal working condition.
BATT FAULT LED (DS3) (Red)	The battery has failed the periodic load test. Approximately once every 24 hours the unit automatically tests the batteries under a 16 amp load for five seconds. If battery voltage drops below 20 volts DC (24 volts nominal), the BATT FAULT LED will light, the PS NORM LED will go out, and the battery fault alarm will activate. The battery fault alarm will also activate if the battery test fails.

AC/DC Power Supply (With Battery Backup) Fuses

The 10P5658000x power supply has two fuses (F1 and F2), and the 1984-0298-000x and 1984-2298-000x power supplies each have one fuse (F1) between the battery charger card and the batteries. Figure 1.2.4 shows the location of the fuse(s). Table 1.2.3 gives fuse data. There are additional fuses on the Battery Charger Card (1984-1283-000x).

Table 1.2.3. AC/DC Power Supply (With Battery Backup) Fuses

Fuse	FRSI Part No.	Bussman Part No.	Littelfuse Part No.	Characteristics
F1	G50527-0004	--	SLC50	50 A 300 V Time Delay
F2	50P03980007	SC-30	--	30 A 300 V Time Delay

Battery Charger Card

The Battery Charger card (1984–1283–000x) contains a battery charging circuit, a battery test circuit, and a board current sense circuit. The card is marked “BATTERY CHARGER AND DISPLAY DRIVER/ALARM” on the printed wiring assembly (PWA). The battery charging circuit charges two 12 volt gel-cell batteries in series. Charge current is limited to 1/2 amp (average) with a nominal charge voltage of 27.6 volts. To prevent complete discharge and possible damage to the batteries, the Battery Charger card contains control circuitry to disconnect the battery if the battery voltage drops below 18 volts. If, during testing, the power supply voltage drops to 26.4 volts, the control circuitry turns on a red LED and Activates an alarm relay. The battery backup circuit can maintain the output load for approximately 30 seconds. The power supply output circuit and battery backup circuits are diode isolated from each other to prevent loading in case either circuit fails.

The battery test circuit consists of a 100 Hz oscillator divided down to 24 hours and 5.12 seconds. Five minutes after power is applied, a test is performed on the batteries under a 16-amp load for 5.12 seconds. The test is automatically repeated every 24 hours. The test may also be initiated manually. If the battery voltage drops below 20 volts, a red LED lights and the alarm relay is activated.

NOTE: A manually initiated battery test will not be permitted until approximately five minutes after power-up or after a previous manual test.

❑ **To Access the Battery Charger card** (refer to Figure 1.2.4)**:**

1. Remove the four screws securing cover A and remove cover A.
2. Remove the single screw securing cover B and open cover B.
3. Disconnect the batteries (plug G).
4. Push the upper edge of the Battery Charger circuit card C toward the rear of the power supply just enough to free it from the standoff.
5. Pull up the card slightly to free it from the card connector.
6. Disconnect cable D from connector J193.
7. Lift the card out of the power supply far enough to note the orientation of connectors J0 and J192 (E). On connector J0 the orange wire is nearest the large heat sink; on connector J192 the yellow wire is nearest T1.
8. Disconnect the cables.
9. Separate the two cards (F).
10. Position the jumpers as desired.

CAUTION

Use caution in removing and replacing boards in the power supply. Some boards are not keyed to prevent improper insertions.

11. Replace the card in the power supply by performing the above steps in reverse order.

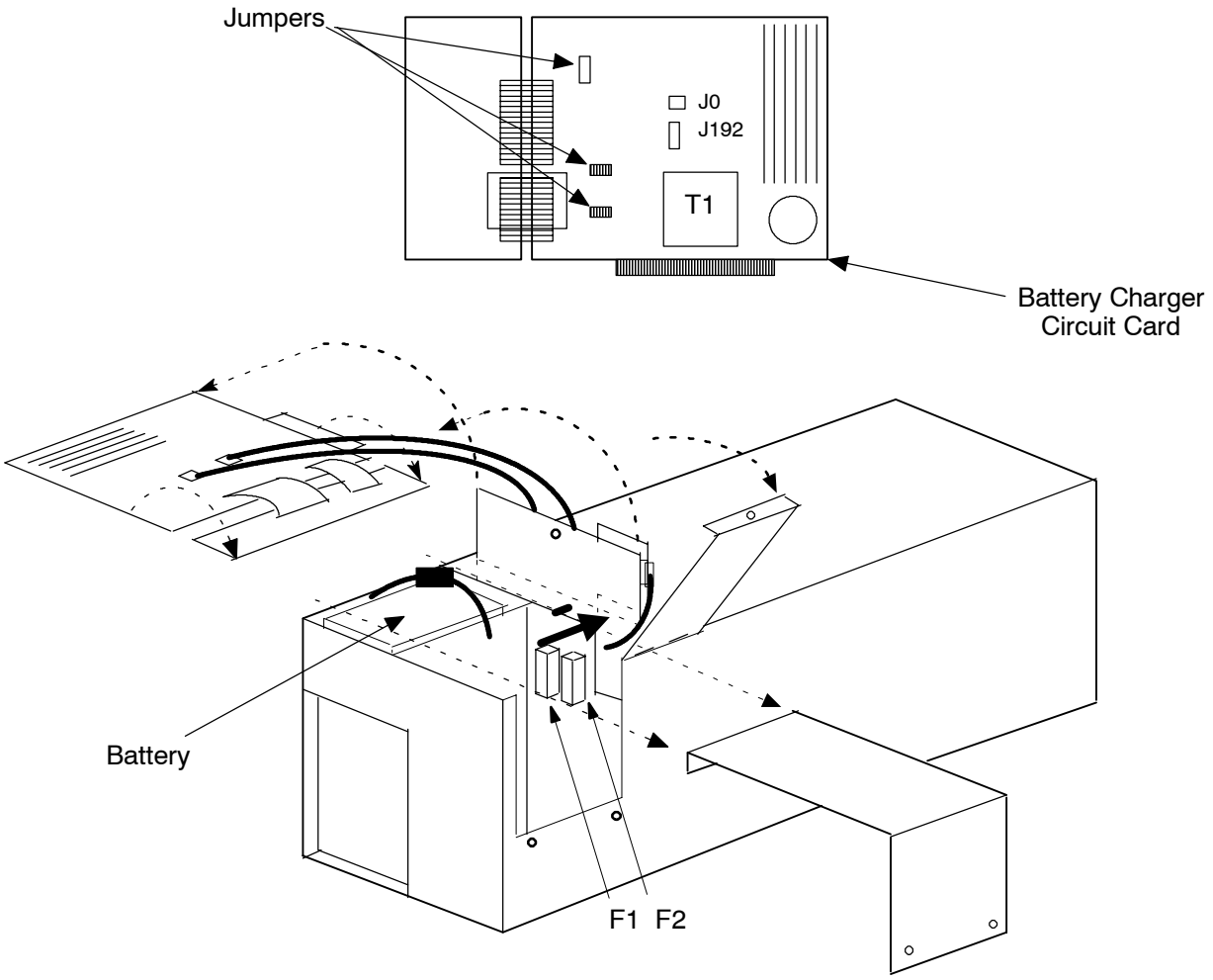


Figure 1.2.4. Accessing the Battery Charger Card

Battery Charger Card Jumpers and Test Points

The Battery Charger card in the AC/DC power supply has three jumpers and three test points. Figure 1.2.5 shows the jumper and test point locations.

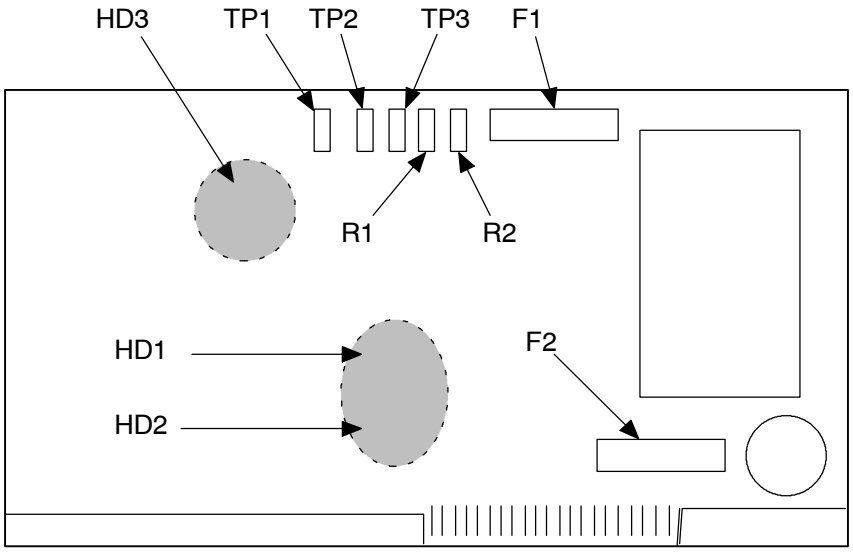


Figure 1.2.5. Battery Charger Board Fuse and Jumper Locations

Jumpers HD1 and HD2 determine the alarm contact condition for power supply and battery fault alarms. If the jumpers are in the “normally open” position, the contacts will be open for no alarm and closed for an alarm.

Jumper HD3 controls use of the battery check circuitry and the BATT FAULT alarm contacts. When HD3 is in the 1–2 position, the battery is tested every 24 hours and the BATT FAULT alarm contacts are active. When HD3 is in the 2–3 position, no testing of the battery occurs, the BATT FAULT alarm contacts are not used, and the battery test pushbutton is inactive.

Table 1.2.4 shows the jumper positions.

Table 1.2.4. Battery Charger Board Jumper Positions

Jumper	Purpose	Position
HD1	Alarm contact for power supply fault	1–2 N.O. – Contact is normally open 2–3 N.C. – Contact is normally closed
HD2	Alarm contact for battery fault	1–2 N.O. – Contact is normally open 2–3 N.C. – Contact is normally closed
HD3	Battery connection	1–2 W BAT – Test Battery every 24 hours 2–3 W/O BATT – Do not test Battery

NOTE: Any adjustments to the battery voltage must be made with the BATT switch in the OFF position.

Table 1.2.5. Battery Charger Card Test Points

Test Point	Function
TP1	Reference to ground
TP2	Reference voltage 2.35 volts (adjusted by variable resistor R1)
TP3	Battery voltage 27.6 volts (adjusted by variable resistor R2)

Battery Charger Card Fuses

Figure 1.2.4 shows the fuse locations. Table 1.2.6 gives fuse data for the Battery Charger card.

Table 1.2.6. Battery Charger Card Fuses

Fuse	FRSI Part No.	Bussman Part No.	Littelfuse Part No.	Characteristics
F1	G09140-0016	AGC 1/2	312.500	.5 A 250 V Quick Acting
F2	G09140-0030	AGC 2	312002	2 A 250 V Quick Acting

Battery Replacement

To replace the batteries on the Battery Charger card,

1. Turn the BATT switch to the OFF position
2. Remove the battery box
3. Install new batteries
4. Reinstall the battery box
5. Turn the BATT switch to the ON position.

AC/DC Power Supply (Without Battery Backup)

The AC/DC Power Supply without battery backup (10P5664000x and 1984-0390-000x) provides 30 volts DC to the DC bus. It is intended for systems that do not require battery backup.

CAUTION

The power supply unit is heavy, approximately 25 kg (55 pounds).

CAUTION

The top surface of the power supply may be hot.

Figure 1.2.6 shows the power supply front panel.

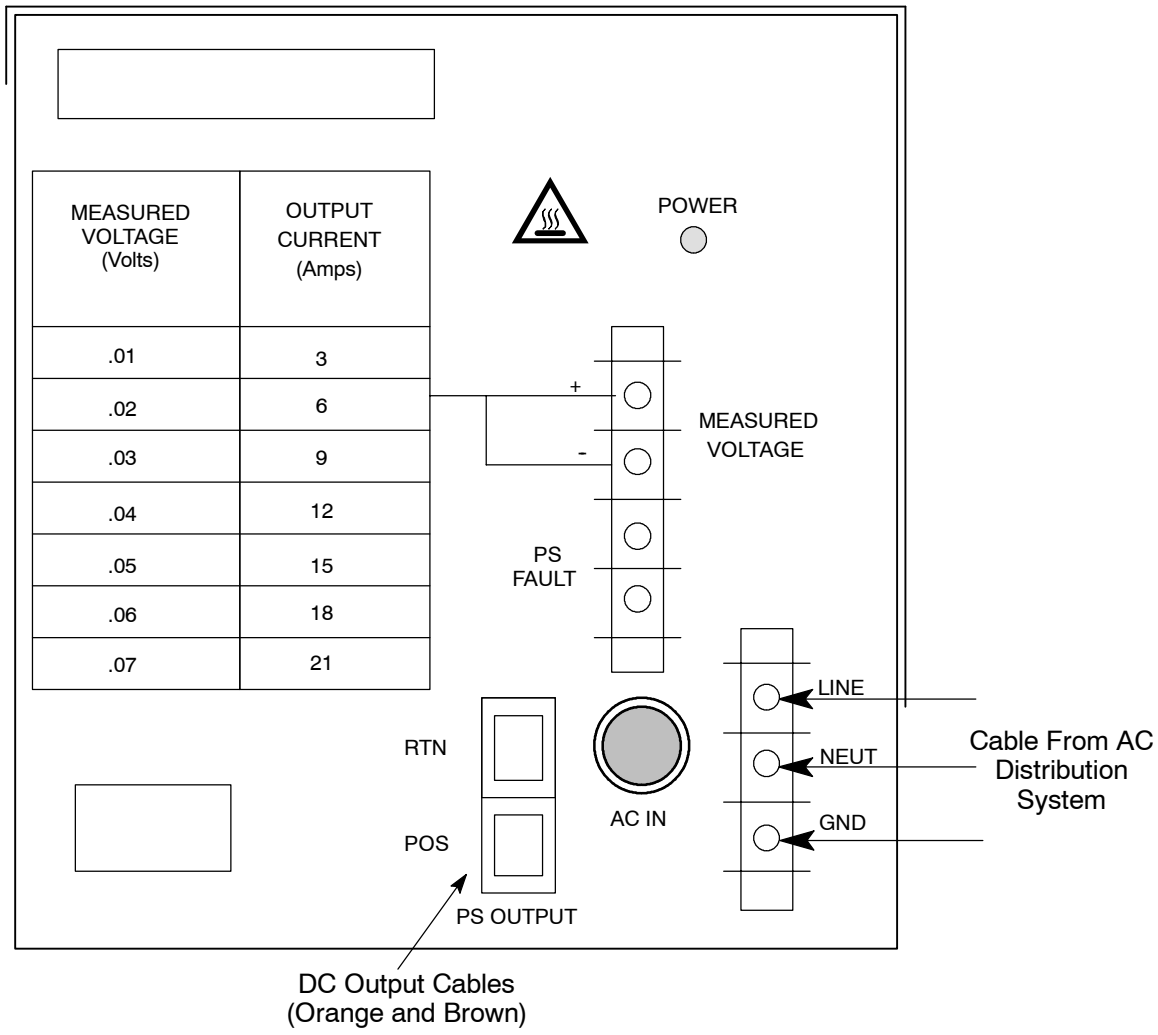


Figure 1.2.6. Power Supply (Without Battery Backup) Front Panel

Table 1.2.7 gives parts replacement data. This power supply can be used with a battery-backed power supply, provided the BATT switches are turned OFF. This power supply can replace a battery-backed supply ONLY if the battery is not being used, the BATT switch is turned off, and the PS FAULT alarm contacts (if used) are jumpered as Normally Closed (N.C.).

Table 1.2.7. AC/DC Power Supply (Without Battery Backup) Parts Replacement

Part No.	Replaces	Comment
10P5664000x	10P5658000x 1984-0390-000x	Power supplies are interchangeable only in systems that do not use batteries. The BATT switch on the replaced unit must be turned OFF. The PS FAULT contact (if used) must be jumpered as Normally Closed (N.C.).
1984-0390-000x	1984-0298-000x or 1984-2298-000x	Power supplies are interchangeable only in systems that do not use batteries. The BATT switch on the replaced unit must be turned OFF. The PS FAULT contact (if used) must be jumpered as Normally Closed (N.C.).

NOTE: The 1984-0390-000x and 10P5664000x power supplies are rated at 20 amps, and the 1984-x298-000x and 10P5658000x power supplies are rated at 22 amps. If you replace a 22-amp supply with a 20-amp supply, make sure that the DC load does not exceed the rating of the replacement power supply.

Figure 1.2.7 shows the functional diagram. The AC/DC power supply uses a ferroresonant core transformer for partial regulation. The transformer primary and secondary have selectable taps for 50 or 60 Hz line frequency. The primary also has taps for 115 or 220 volts AC input. The third winding on the primary side is isolated and has a parallel capacitor. This regulates transformer output voltage by providing extra voltage to the circuit from power stored in the resonant circuit. The third winding also inherently limits current.

NOTE: Because the transformer is self-regulating, no other power conditioning is necessary. Do not use an isolation transformer, voltage regulating power source, or uninterruptible power supply with a ferroresonant transformer as its output device unless it is rated at least 3 kVA for each standard AC/DC power supply it powers. Use of a smaller ferroresonant transformer can result in oscillations.

Output current is measured by measuring the voltage drop across a .0033 ohm precision resistor that is in series with the output.

The POWER LED and the PS FAULT relay are on a replaceable board (1984-3442-0003) marked “POWER SUPPLY DISPLAY III” on the PWA.

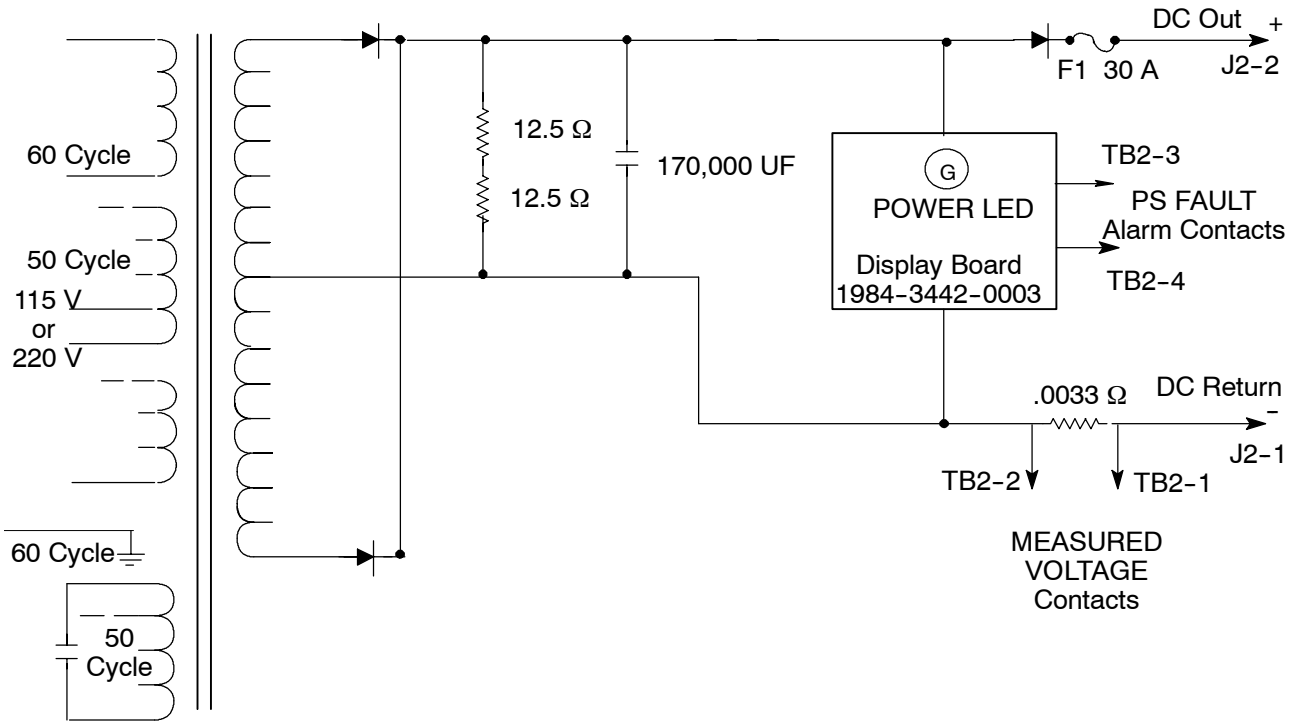


Figure 1.2.7. AC/DC Power Supply (Without Battery Backup) Functional Diagram

AC/DC Power Supply (Without Battery Backup) Measuring Output Current

Output current is measured by reading the voltage drop across a .0033 ohm precision resistor in series with the output. TB2 contacts 1 and 2 provide access to the resistor. A table is provided on the front panel to assist in converting the measured voltage drop to output current. Steps in the table correspond to LED segments on the -2298, -0298, and 10P5658000x power supplies.

The precise current output can be calculated from Ohm's Law:

E = I*R

I = E/R = (Volts)/(Resistance) = (Volts)/ 0.0033 = 303 x Volts

I = 303 x Voltage Reading

AC/DC Power Supply (Without Battery Backup) Alarm Contacts

The front panel provides a set of terminals for power supply fault alarm contacts (PS FAULT). These are normally closed (N.C.). The contact will be opened if the green PS NORM LED goes out. The supply continues to supply power when the alarm condition is active. The contacts are rated for switching a resistive load.

Rating for 1984-0390-000x:

- 200 Volts DC
- 500 mA
- 10 Watts

Rating for 10P5664000x:

- 100 Volts DC
- 500 mA
- 10 Watts

NOTE: The PS FAULT contacts of the 1984-0390-000x and 10P5664000x power supplies are normally closed (N.C.).

AC/DC Power Supply (Without Battery Backup) LEDs and Fuses

The AC/DC power supply (without battery backup) has two indicators on the front to indicate status. Figure 1.2.8 shows the location of the lights. Table 1.2.8 shows the meaning of each light.

Table 1.2.9 shows the power supply fuse.

CAUTION

Under certain failure conditions, 30 VDC may be present even though both LED indicators are off.

Check all AC/DC power supplies for green LED normal indications and equal output current. All supplies on the same DC distribution system supply approximately the same current within 3 to 6 amps. Check each DC distribution system individually.

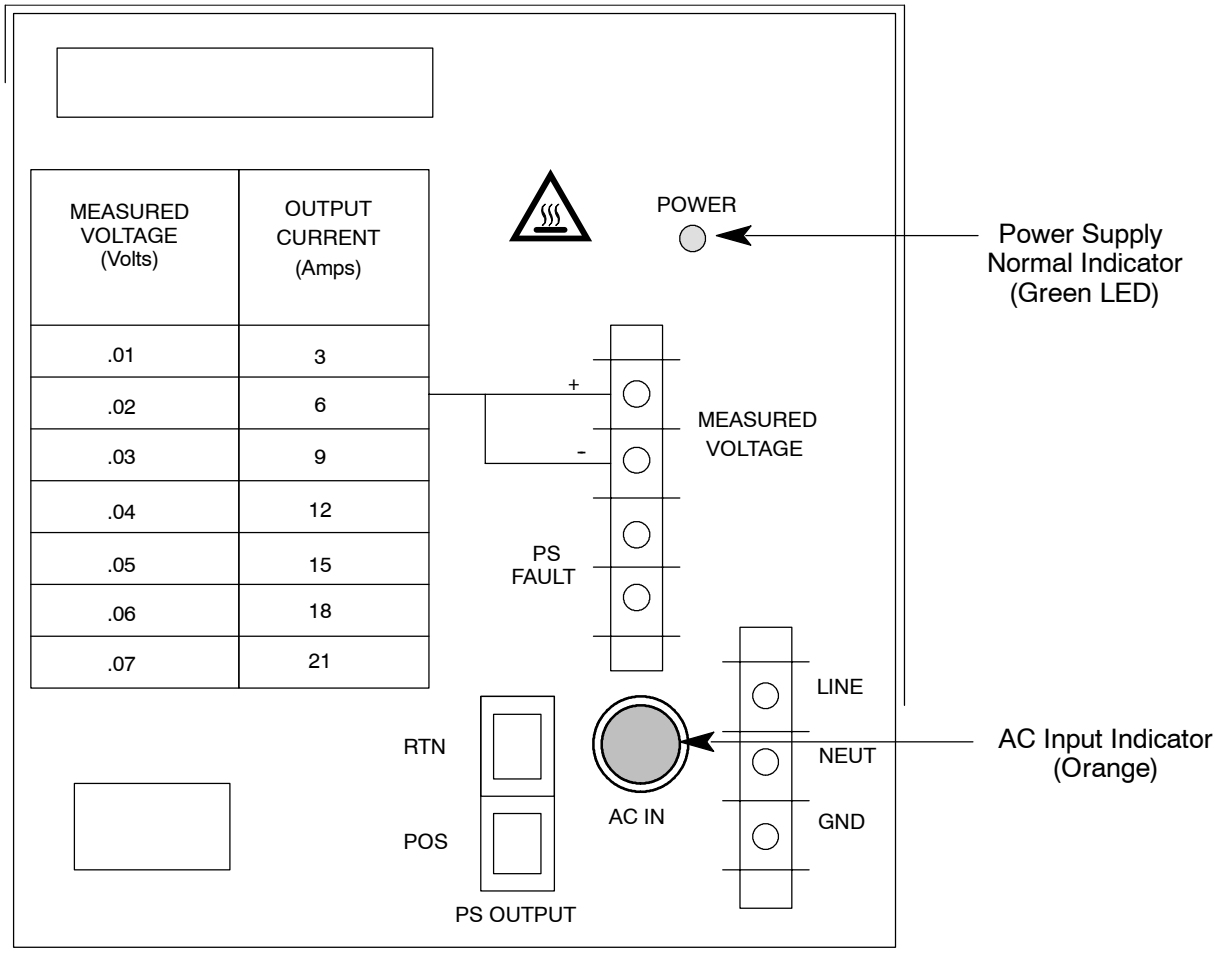


Figure 1.2.8. Power Supply (Without Battery Backup) Panel Indicators

Table 1.2.8. Power Supply (Without Battery Backup) Indicators

Item	Function
AC IN (Orange)	Indicates that AC input is present.
POWER (Green)	Indicates that the DC output voltage is in normal working range. The power supply alarm is activated when this LED is off.

Table 1.2.9. 10P5664000x AC/DC Power Supply (Without Battery Backup) Fuse

Fuse	FRSI Part No.	Bussman Part No.	Characteristics
F1	50P03980007	SC-30	30 A 300 V Time Delay

MTCC Remote Power Supply

The Multitube Command Console (MTCC) Remote Power Supply (10P5645000x and 1984-3023-000x) is used when powering a MTCC from a remote location. A remote location is defined as being more than 200 feet from the AC/DC distribution panel. The MTCC Remote Power Supply is mounted inside the electronics cabinet of a MTCC. It receives AC power from an AC distribution switch assembly (1984-3004-000x) also mounted in the electronics cabinet.

This power supply assembly consists of an electronics box and two attached cables. There are no batteries associated with this supply. Figure 1.2.9 shows the assembly.

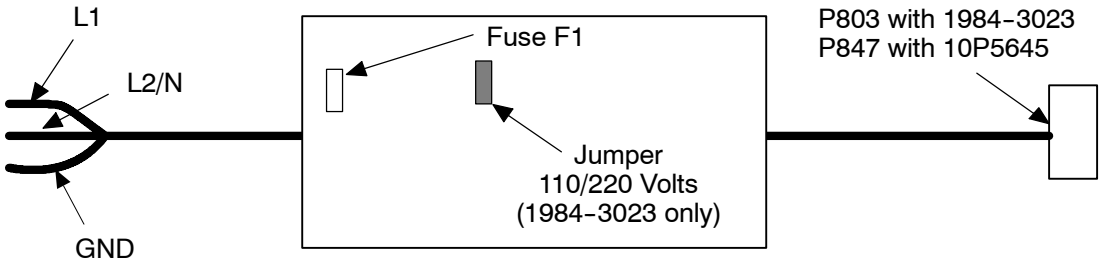


Figure 1.2.9. 10P5645000x and 1984-3023-000x MTCC Remote Power Supply

MTCC Remote Power Supply Jumper

On the 1984-3023-000x power supply, an internal jumper wire changes the input voltage from 110 volts to 220 volts. The jumper wire is in place for 110 volt input (-0001) and removed for 220 volt input (-0002).

NOTE: The 10P5645000x power supply is autosensing for AC input voltage, and does not require a jumper.

MTCC Remote Power Supply Fuse

There is an internal fuse on the AC input. Table 1.2.10 gives fuse data.

Table 1.2.10. MTCC Remote Power Supply Fuses

Fuse	FRSI Part No.	Bussman Part No.	Littelfuse Part No.	Characteristics
F1 power supply: 1984-3023-000x	G09140-0064	GMC5	--	5 A 250 V Miniature
F1 power supply: 10P5645000x	G09140-0041	MTH5	312005	5 A 250 V 1-1/4 in.

OI Remote Power Supply

The OI (Operator Interface) Remote Power Supply (1984-1046-000x) is used when powering a Multitube Command Console, Command Console, or MiniConsole from a remote location. A remote location is defined as being more than 200 feet from the system. The OI remote power supply is either mounted inside the electronics cabinet of a Multitube Command Console, inside a Command Console pedestal, or standing alone when used with a MiniConsole.

The OI Remote AC/DC power supply operates similarly to the system AC/DC power supply. Figure 1.2.10 shows a functional diagram of the power supply. The OI Remote AC/DC supply does not use an AC distribution panel, so a fan, filter, fuse, and circuit breaker have been added to the power supply itself. A 10 amp thermal type circuit breaker is used at the input.

An optional Battery Charger card in the power supply slowly charges the backup batteries, protects against momentary AC voltage drops, and contains contacts for external alarms if a voltage drop occurs. The Battery Charger card and batteries are not required for DC output from the power supply.

The Battery Charger card contains a battery charging circuit and a battery test circuit. The battery charging circuit charges two 12 volt gel-cell batteries in series. Charge current is limited to 1/2 amp (average) with a nominal charge voltage of 27.6 volts. To prevent complete discharge and possible damage to the batteries, the Battery Charger card contains control circuitry to disconnect the battery if the battery voltage drops below 18 volts. If, during testing, the power supply voltage drops to 26.4 volts, the control circuitry turns on a red LED and activates an alarm relay. The battery backup circuit can maintain the output load for approximately 30 seconds. The power supply output circuit and battery backup circuits are diode isolated from each other to prevent loading in case either circuit fails.

The battery test circuit consists of a 100 Hz oscillator divided down to 24 hours and 5.12 seconds. Five minutes after power is applied, a test is performed on the batteries under a 16 amp load for 5.12 seconds. The test is automatically repeated every 24 hours or can be initiated manually. If the battery voltage drops below 20 volts, a red LED lights and the alarm relay is activated.

NOTE: A manually initiated battery test will not be permitted until approximately five minutes after power-up or after a previous manual test.

The OI Remote Power Supply is essentially identical to the AC/DC Power Supply (1984-2298-000x, 1984-0298-000x, or 10P5658000x) covered earlier in this section.

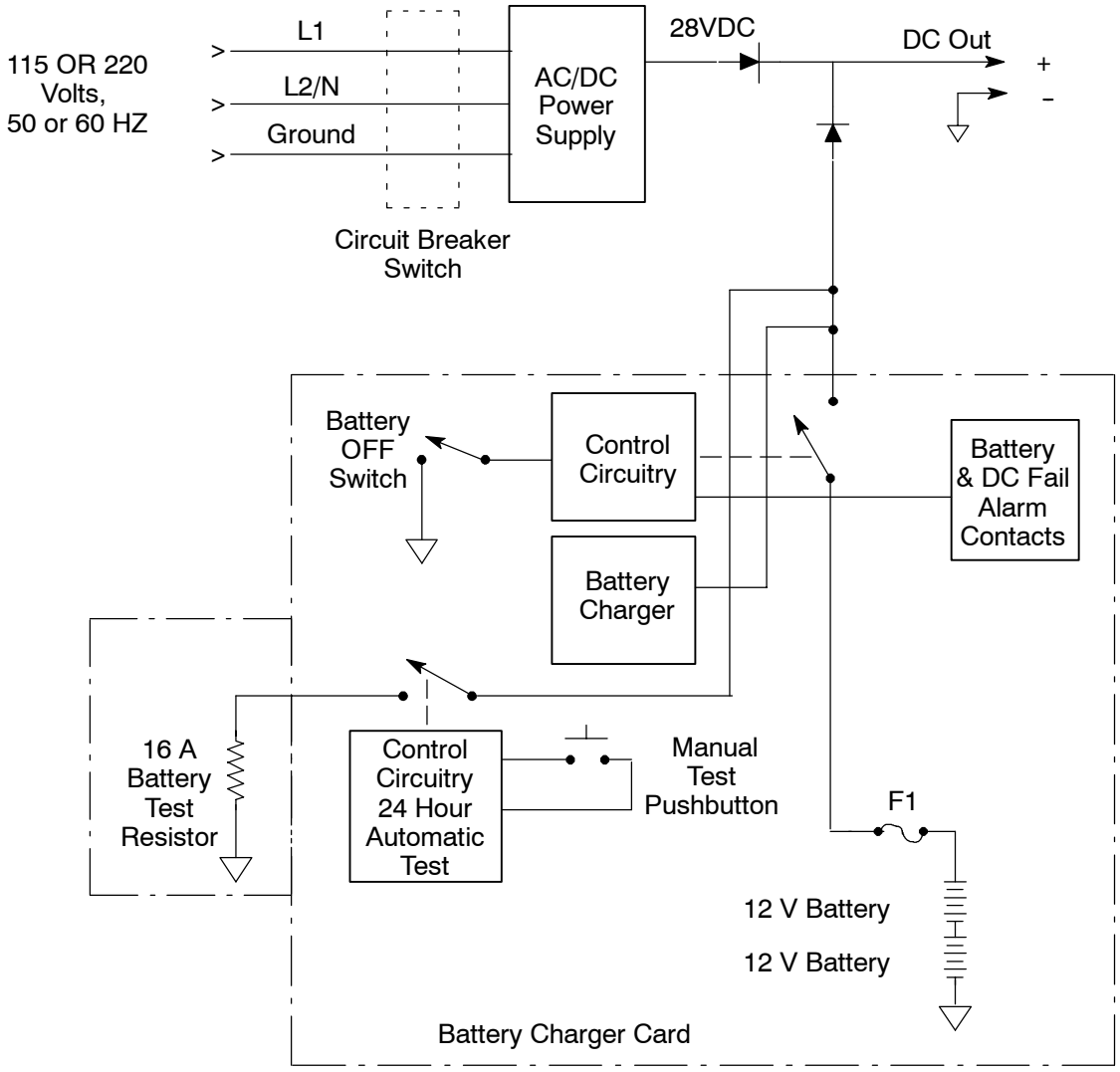


Figure 1.2.10. OI Remote Power Supply Functional Diagram

OI Remote Power Supply Fuse

The OI Remote Power Supply has a fuse between the battery charger card and the batteries. It is located on the partition panel, in front of the printed circuit board. Table 1.2.11 shows fuse data.

Table 1.2.11. OI Remote Power Supply Fuse

Fuse	FRSI Part No.	Bussman Part No.	Littelfuse Part No.	Characteristics
F1	G50527-0004	--	SLC50	50 A 300 V Time Delay

DC/DC Power Supply

The DC/DC Power Supply (1984-0393-000x) supplies power to remotely powered devices. The DC/DC supply receives 30 volts DC from the system power supplies and uses a 25 K Hz switching regulator to provide a 24 volts DC or 15 volts DC volt output to external devices.

The output of the DC/DC power supply is preset at the factory. The output of the DC/DC power supply is wired in parallel to five pairs of terminal blocks. Each terminal block has positive and negative terminals. The positive terminal of each output is fused at 3 amps. **Do not exceed the rated output current of the supply.**

Figure 1.2.11 shows a functional diagram for connecting a single DC/DC power supply.

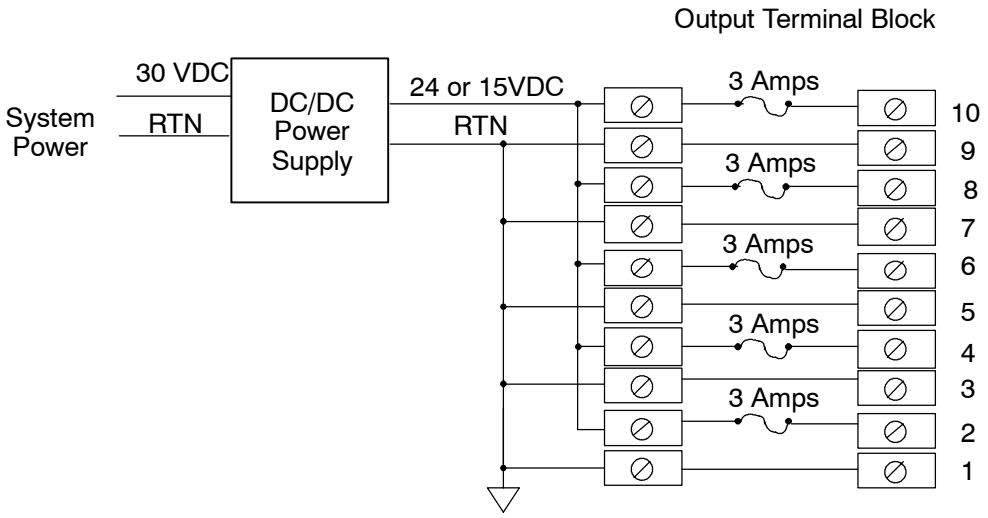


Figure 1.2.11. DC/DC Power Supply Functional Diagram

An optional power switching box can be used to create a redundant DC power supply. Figure 1.2.12 shows a functional diagram for connecting redundant DC/DC power supplies.

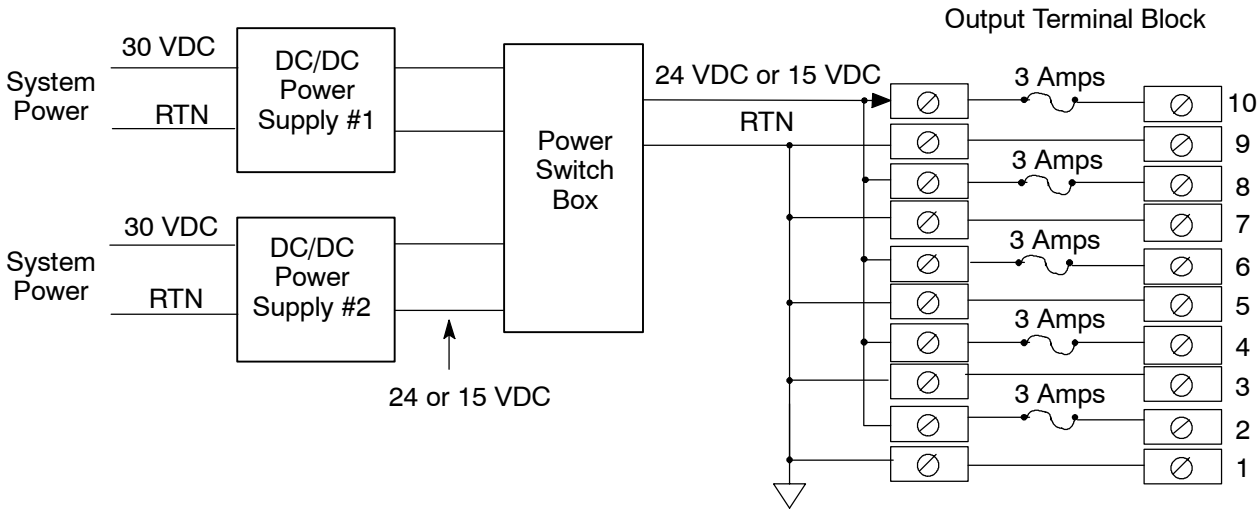


Figure 1.2.12. Redundant DC/DC Power Supply Functional Diagram

Table 1.2.12 gives specifications for the DC/DC Power Supplies.

Table 1.2.12. DC/DC Power Supply Specifications

Parameter	Specification
Power supply type	Switching regulator
Temperature range	0° C to 50° C
Input voltage	30 volts DC
Input voltage range	10 volts DC to 60 volts DC
Line regulation	± .5% with input voltage >15 volts
Output voltage	1984-0393-0001: set @ 24 volts DC 1984-0393-0002: set @ 24 volts DC 1984-0393-0003: set @ 15 volts DC
Output voltage range	4.4 volts DC to 30 volts DC
Output current	0 to 12 amps
Output ripple	50 millivolts (0-25K Hz) 150 millivolts (total)

DC/DC Power Supply Fuses

Table 1.2.13 shows fuse data for the DC/DC Power Supply.

Table 1.2.13. DC/DC Power Supply Fuses

Fuse	FRSI Part No.	Bussman Part No.	Littelfuse Part No.	Characteristics
All	G09140-0036	MDL 3	313003	3 A 250 V Slow Blow

AC/DC Unregulated Power Supply

The 1984-1089-000x AC/DC Unregulated Power Supply supplies power to a remote MiniConsole positioned more than 200 feet from the system 30 volt DC bus. Figure 1.2.13 shows a functional diagram for the AC/DC Unregulated Power Supply.

The power supply input is protected by a 15 amp circuit breaker. The output of the power supply is fused at 10 amps.

An overvoltage protection circuit in the AC/DC supply activates at voltages greater than 40 volts DC.

Table 1.2.14 has specifications for the AC/DC unregulated power supply.

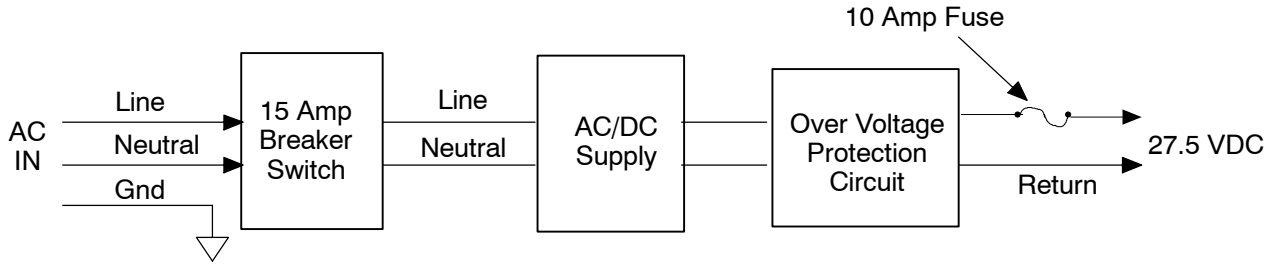


Figure 1.2.13. AC/DC Unregulated Power Supply Functional Diagram

Table 1.2.14. AC/DC Unregulated Power Supply Specifications

Parameter	Specification
Voltage	1984-1089-0001: 115 volts AC 1984-1089-0002: 220 volts AC
Input Voltage Range	1984-1089-0001: 104 to 127 volts AC 1984-1089-0002: 198 to 242 volts AC
Frequency Range	47 to 63 Hz
Output Source	Nominal: 27.5 volts, 7.5 amps

AC/DC Unregulated Power Supply Fuses

Table 1.2.15 shows fuse data for the AC/DC Unregulated Power Supply.

Table 1.2.15. AC/DC Unregulated Power Supply Fuse

Fuse	FRSI Part No.	Bussman Part No.	Littelfuse Part No.	Characteristics
F1	G01940-0046	AGC 10	311010	10 A 32 V Regular

Remote I/O Power Supply

The DIN rail mounted Remote I/O Power Supply can be used to supply DC power to distributed I/O termination panels mounted in I/O cabinets. The supply is assembled as required from these components:

• Remote I/O Power Supply	10P55030001	230 VAC
	10P55030002	115 VAC
	1984-4302-0001	110 VAC
	1984-4302-0002	220 VAC
• AC Distribution Block	1984-4329-0001	(2 circuits)
• DC Distribution Block	1984-4329-0002	(10 circuits)
	1984-4329-0003	(1 circuit)
• AC/DC Distribution Block	1984-4329-0004	(2 AC 10 DC circuits)
• DC I/O Power Cable(s)	1984-4337-xxxx	(Bus A cable)
	1984-4433-xxxx	(Bus B cable)
• Fuse Label	1984-4350-000x	
• DIN Rail (optional)	1984-4309-0004	

Figure 1.2.14 shows a typical assembly.

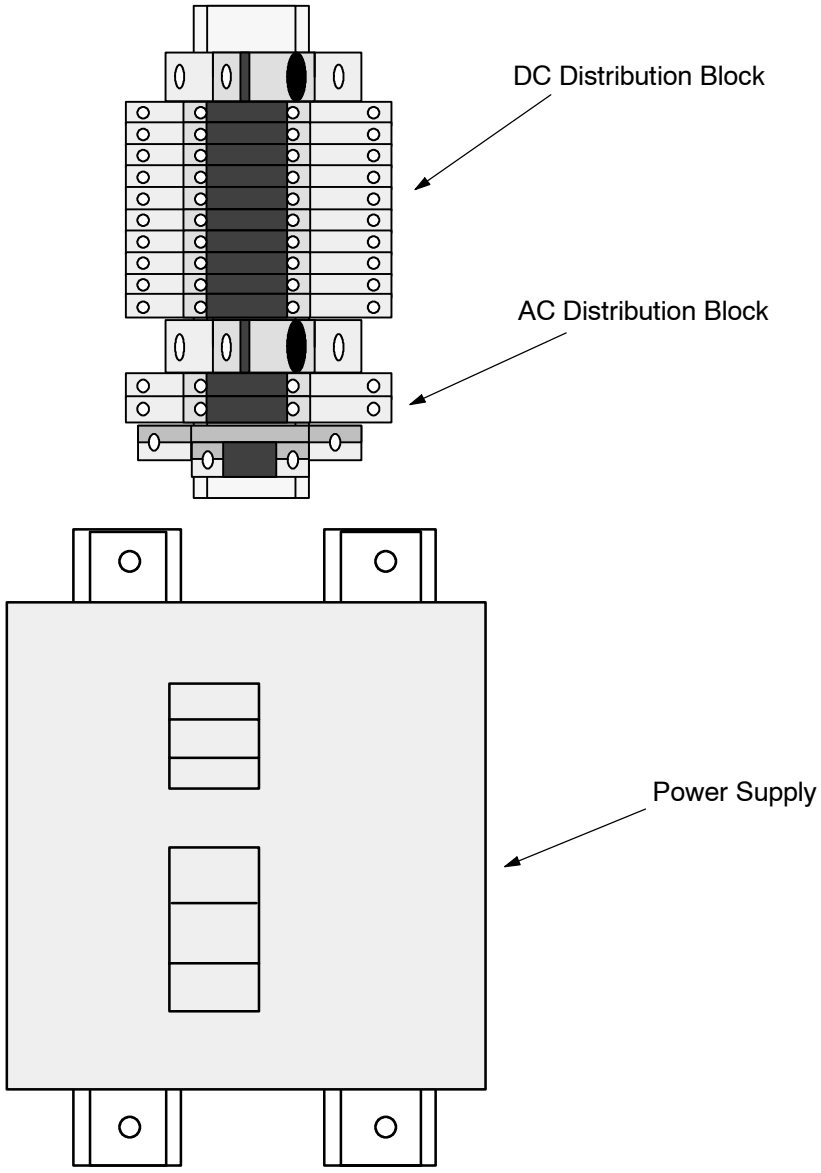
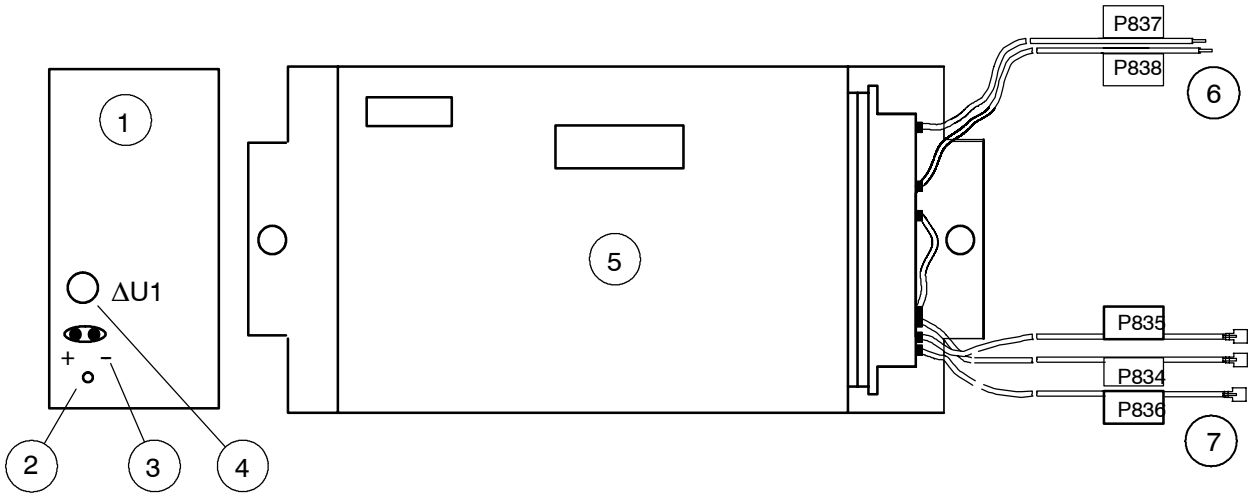


Figure 1.2.14. Typical Remote I/O Power Supply Assembly

10P5503 for I/O Applications

This configuration supplies power to I/O panels located away from the main system DC bus. Figure 1.2.15 shows the unit.



No.	Description	No.	Description
1	Front view	5	Top view
2	Green LED	6	DC output: P837 (Orange) +24 v P838 (Brown) Return
3	Test socket for output voltage measurement	7	AC input: P834 (Black) L1 P835 (White) L2/N P836 (Green) Ground
4	Potentiometer for output voltage adjustment		

Figure 1.2.15. 10P5503 Power Supply

NOTE: A cooling fan assembly is required for the cabinet holding the power supply.

10P5503 Remote Power Supply Connector Pin-Out

A connector is used to mount the cables on the power supply. The pin-out of the connector is shown in Table 1.2.16.

Table 1.2.16. 10P5503 Remote Power Supply Connector Pin-Out

Pin	Description
6	DC + output
14	DC return
16	Jumper to pin 32 (connects DC return to AC safety ground)
28	L1 AC line 1
30	L2/N AC line 2 (230 V) or neutral (115 V)
32	AC safety ground

10P5503 Remote Power Supply LEDs

The power supply has one green LED that lights when the unit is operating normally.

10P5503 Remote Power Supply Checking and Adjusting Output

Adjustment should not be required. Attach a voltmeter to the test jack to monitor the output voltage. Adjust the voltage ($\pm$ 1 Volt) with the adjustment potentiometer (ΔU1).

10P5503 Remote Power Supply Fuses

Table 1.2.17 shows fuse data for the Remote Power Supply.

Table 1.2.17. 10P5503 Remote Power Supply Fuse

FRSI Part No.	Wickman Part No.	Schurter Part No.	Characteristics
--	19372K	Series MST 250	3.15 A, 250 V Slow Blow, Plug-In

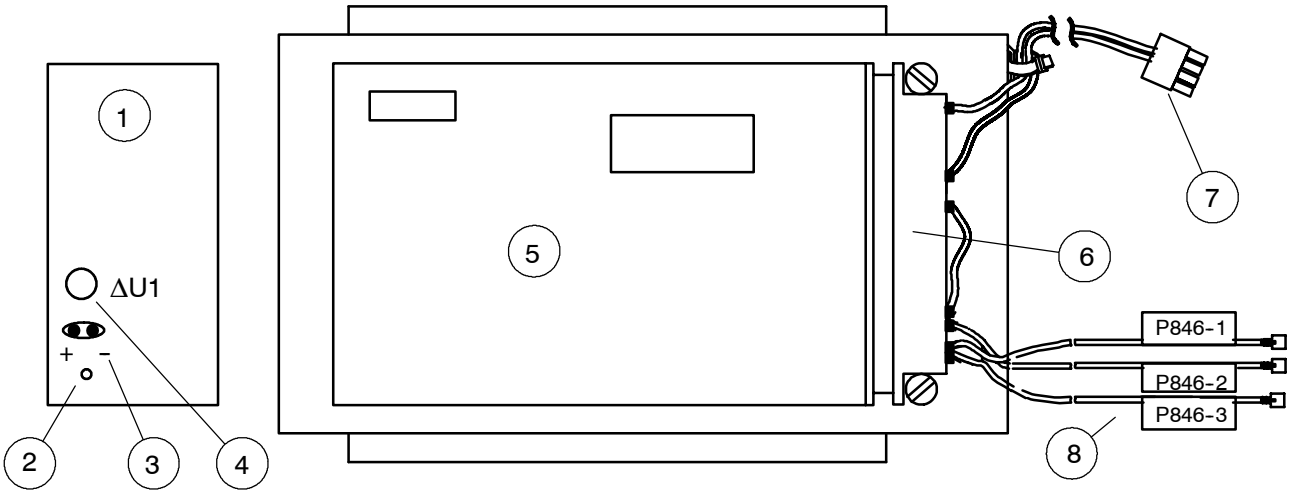
Remote Operator Interface Power Supply

The Remote Power Supply is available in these versions:

- For Operator Interface products:
  - 230 VAC input 10P54090001, 3
  - 115 VAC input 10P54090002, 4
  - 110–230 VAC input 10P57010001
  - 110–230 VAC input 10P57560001

10P5409 for Operator Interface Applications

This configuration supplies power to OI card cages located away from the main system DC bus. Figure 1.2.16 shows the 10P54090003 and 4.



No.	Description	No.	Description
1	Front view	5	Top view
2	Green LED	6	Connector
3	Test socket for output voltage measurement	7	DC output cable (connector P981 goes to J907 PWRA on the OI Card Cage)
4	Potentiometer for output voltage adjustment	8	AC input: P846–1 (Black) L1 P846–2 (White) L2/N P846–3 (Green) Ground

Figure 1.2.16. 10P5409 Power Supply

The power supply can be mounted in a Suspended Cabinet (“7U”), a “11U”, or a “13U” enclosure using the Power Supply Mounting Bracket (10P53760001) which is part of the assembly. The bracket attaches to the drive mounting bracket.

NOTE: A cooling fan assembly is required under the slot that holds the power supply.

10P5409 Remote Power Supply Connector Pin-Out

A connector is used to mount the cables on the power supply. The pin-out of the connector is shown in Table 1.2.18.

Table 1.2.18. 10P5409 Remote Power Supply Connector Pin-Out

Pin	Description
6	DC + output
14	DC return
16	Jumper to pin 32 (connects DC return to AC safety ground)
28	L1 AC line 1
30	L2/N AC line 2 (230 V) or neutral (115 V)
32	AC safety ground

10P5409 Remote Power Supply LEDs

The power supply has one green LED that lights when the unit is operating normally.

10P5409 Remote Power Supply Checking and Adjusting Output

Adjustment should not be required. Attach a voltmeter to the test jack to monitor the output voltage. Adjust the voltage ($\pm$ 1 Volt) with the adjustment potentiometer (ΔU1).

10P5409 Remote Power Supply Fuses

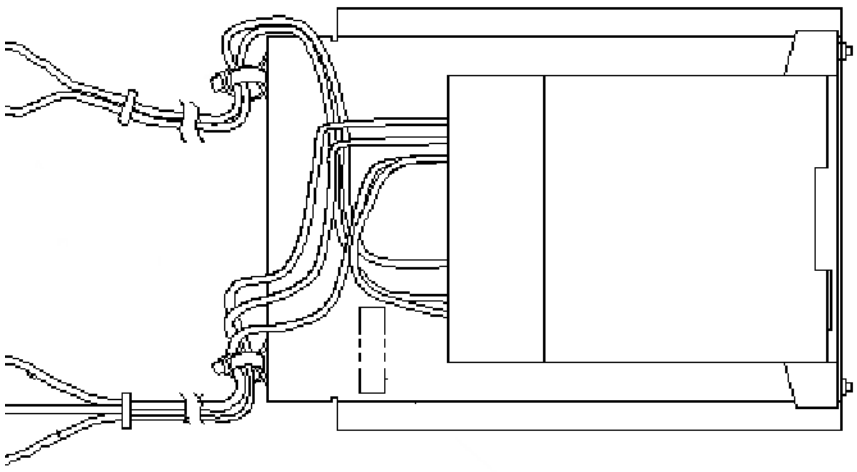
Table 1.2.19 shows fuse data for the Remote Power Supply.

Table 1.2.19. 10P5409 Remote Power Supply Fuse

FRSI Part No.	Wickman Part No.	Schurter Part No.	Characteristics
--	19372K	Series MST 250	3.15 A, 250 V Slow Blow, Plug-In

10P5701 for Operator Interface Applications

This configuration supplies power to OI card cages located away from the main system DC bus. Figure 1.2.17 shows the unit.



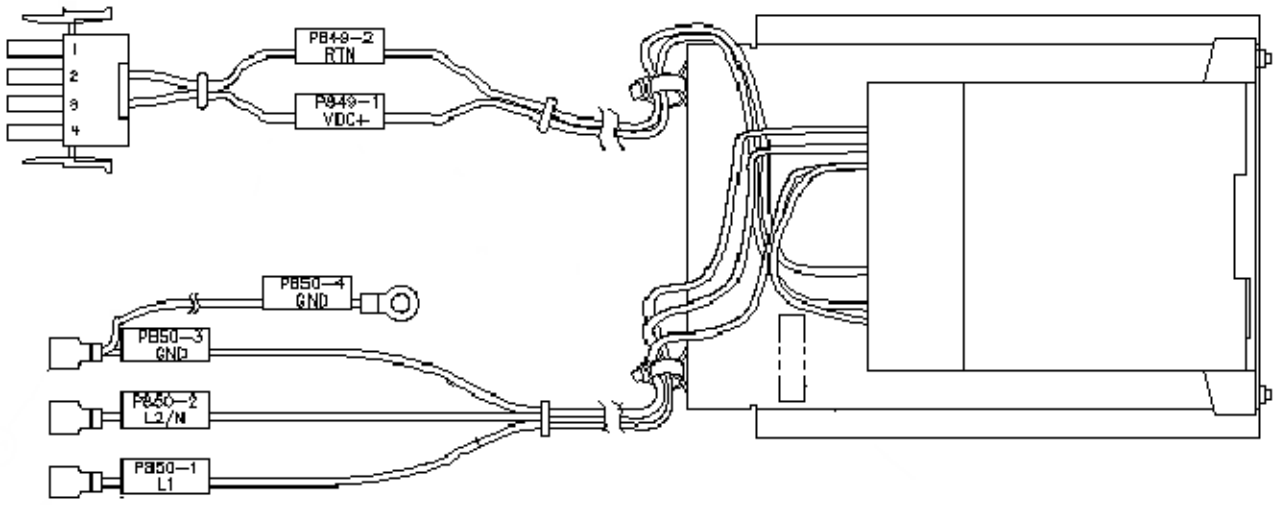
No.	Description	No.	Description
1	DC output (Orange) +24 v (Brown) Return	2	AC input: (Black) L1 (White) L2/N (Green) Ground

Figure 1.2.17. 10P5701 Power Supply

NOTE: A cooling fan assembly is required for the cabinet holding the power supply.

10P5756 for Operator Interface Applications

This configuration supplies power to OI card cages located away from the main system DC bus. Figure 1.2.18 shows the unit.



No.	Description	No.	Description
1	DC output cable (connector P981 goes to J907 PWRA on the OI Card Cage)	2	AC input: P850-1 (Black) L1 P850-2 (White) L2/N P850-3 (Green) Ground

Figure 1.2.18. 10P5756 Power Supply

The power supply can be mounted in a Suspended Cabinet (“7U”), a “11U”, or a “13U” enclosure using the power supply mounting bracket, which is part of the assembly. The bracket attaches to the drive mounting bracket.

NOTE: A cooling fan assembly is required under the slot that holds the power supply.

Distribution Blocks

The AC and DC distribution blocks have all like terminals jumpered together on the input side. Jumper the neutrals with an internal bar. The active terminals are jumpered with an external bridging jumper which must not be removed. The input side is marked with an “I”.

CAUTION

Input power must be connected to the input side of the distribution block. All circuits will be controlled by a single fuse if this is not done.

Distribution Block Fuses

Distribution block fuses are mounted inside the black fuse module at the top of the block. Each fuse module has a bulb that lights if the fuse is blown. The fuse module also acts as a disconnect switch, remove the fuse module to open the circuit. The fuse is reached by prying the fuse module cover open. Table 1.2.20 shows the factory installed fuse values.

Table 1.2.20. Distribution Block Fuses

Block	Wickman P/N	Littelfuse P/N	FRSI P/N	Characteristics
AC Distribution	Series 19197	Series 235	G53394-3000-1	3.0 amp 250 V CSA approved
DC Distribution 10 Circuits	Series 19197	Series 235	G53394-1000-1	1.0 amp 250 V CSA approved
DC Distribution 1 Circuit	Series 19197	Series 235	G53394-3000-1	3.0 amp 250 V CSA approved

A label (1984-4350-000x) is provided to record the actual fuse sizes installed in the AC and DC distribution blocks. The label should be installed inside the I/O cabinet door or as close to the power supply as practical. Standard fuse sizes are listed on the label; be sure to record any changes from the standard.

Section 3:
System Power Supply Units

The RS3 System Power Supply Unit is standard equipment in an RS3 Millennium Package (RMP). It is also standard equipment in most newer RS3 system cabinets. The RS3 System Power Supply Unit normally consists of two power supply modules (12P0238X012) and a housing (12P0236X012).

This section describes physical and electrical descriptions of the System Power Supply Unit along with installation instructions and specifications.

NOTE: The 12P0238X012 power supplies cannot be mixed with 10P5658-XXXX, 1984-2298-XXXX, 1984-0298-XXXX, 10P5664-XXXX, or 1984-0390-XXXX AC/DC power supplies on the same DC bus.

Physical Description

The RS3 System Power Supply Unit is installed in an RS3 system cabinet or an RMP cabinet, providing regulated DC power for equipment installed in the cabinets.

The System Power Supply Unit does not require an AC entrance panel.

The System Power Supply Unit with two power supply modules has a 2400-watt output capacity, with 74 amperes available, at 80% loading. A housing can contain either one or two 1200-watt power supply modules that provide DC power. If a housing contains only one power supply module, it should be installed in the right side of the housing (PS1 position).

The housing contains input and output connectors, alarm connectors, and circuit breakers for the auxiliary outputs. All connections are on the front of the housing. Rear and side access to the housing are not required.

Figure 1.3.1 shows a housing with two power supply modules installed.

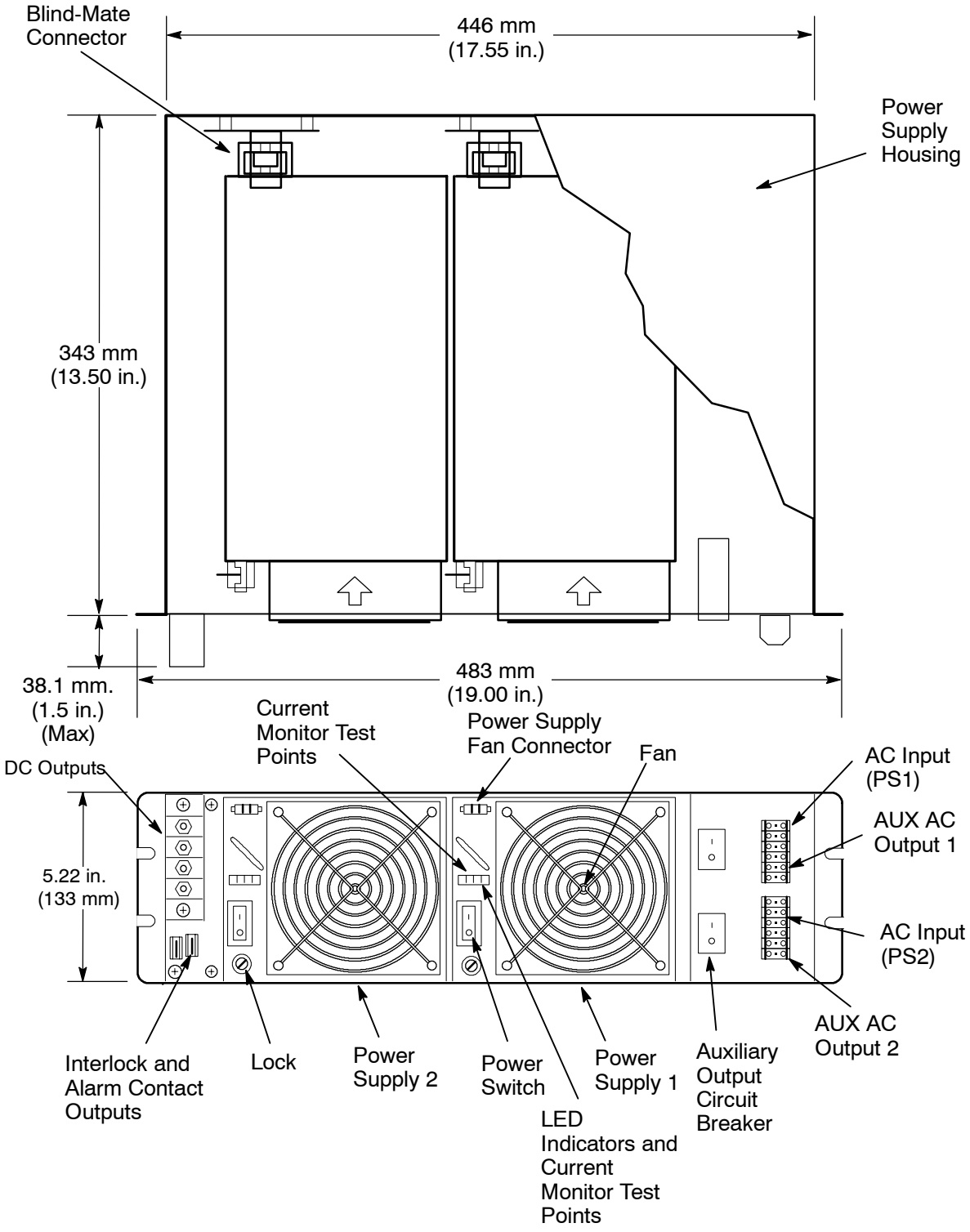


Figure 1.3.1. System Power Supply Unit with Two Power Modules Installed

Housing

Figure 1.3.2 shows the System Power Supply Unit housing (12P0236X012). The housing mounts on standard 483 mm (19-in.) EIA rails in an RS3 system cabinet. Rack height is 133 mm (5.25 in.) with a depth of 343 mm (13.5 in.) from the mounting flange. The housing supports two power supply modules and contains separate DC output terminals for each power supply.

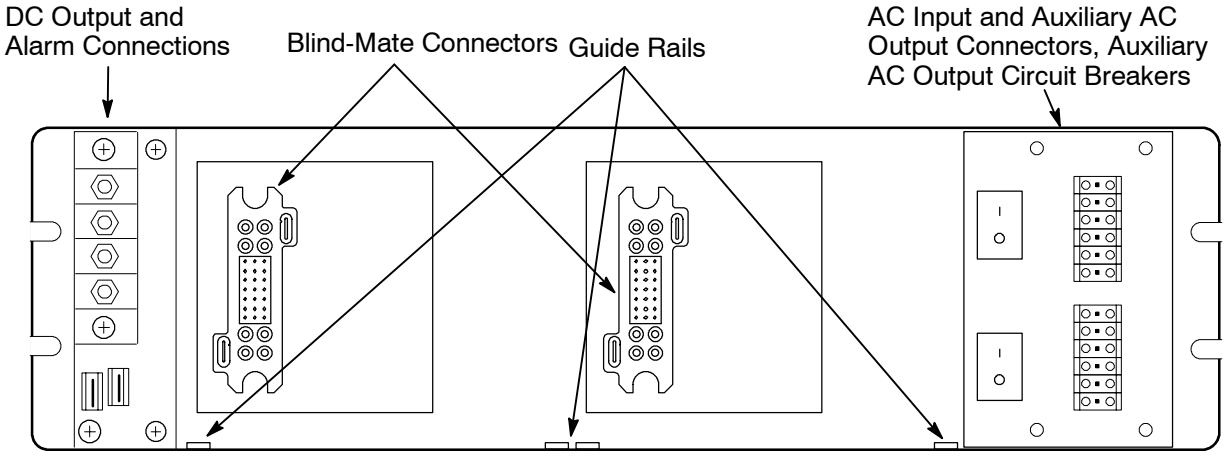


Figure 1.3.2. System Power Supply Unit (Housing Only)

Figure 1.3.3 shows the DC output block on the housing. The housing contains separate DC output terminals for each power supply module. The figure also shows the alarm connections on the housing. The alarm connections do not require wire terminating lugs.

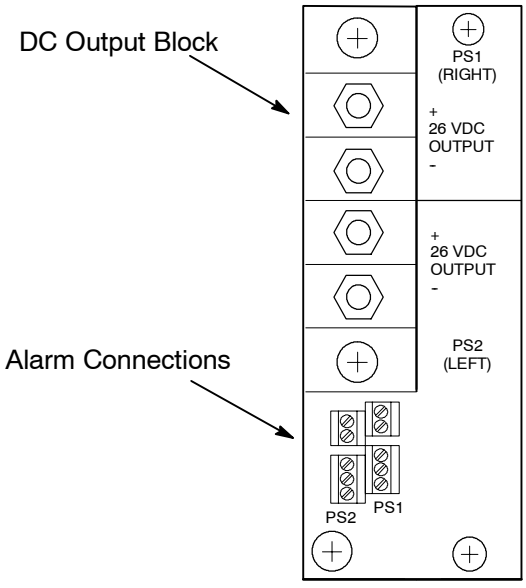


Figure 1.3.3. DC Output and Alarm Connections

Figure 1.3.4 shows the AC input connectors and the auxiliary AC output connectors and circuit breakers.

CAUTION

European installations require external switches or circuit breakers that break both the line and neutral connections of the AC inputs. (The circuit breakers provided for the auxiliary AC outputs are single-pole and break only the line side.)

The housing includes terminal blocks for two AC input sources. This enables each power supply in a housing to be connected to a separate AC source. The chassis of the power supply housing is internally bonded to the ground terminal of each AC input terminal block.

INPUT 1 is routed directly to PS1 (the power supply module on the right side of the housing), and is routed to AUXILIARY OUTPUT 1 through the AUX OUT 1 circuit breaker. INPUT 2 is routed directly to PS2 (the power supply module on the left side of the housing), and is routed to AUXILIARY OUTPUT 2 through the AUX OUT circuit breaker (see Figure 1.3.1 and Figure 1.3.4).

Separate 5-position terminal blocks are provided on the front left hand side of the housing to access the alarm relay contacts and interlock for each power supply (see Figure 1.3.1, Figure 1.3.2, and Figure 1.3.3).

Terminal blocks, circuit breakers, and all wiring connections are on the front of the housing. The housing does not require side or rear access.

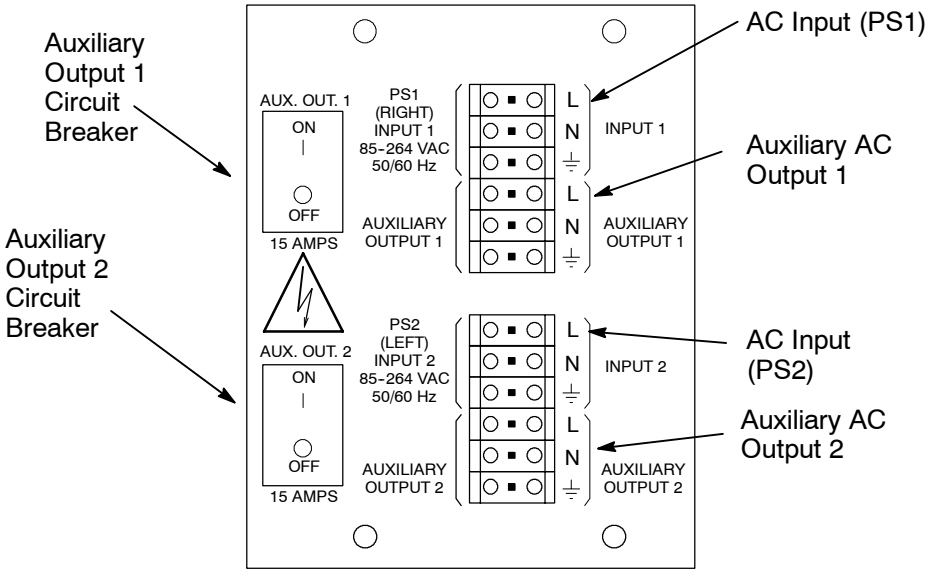


Figure 1.3.4. Input and Output Connectors and Auxiliary Output Circuit Breakers

Power Supply Modules

Each power supply module (12P0238X012) has a brushless DC fan to provide cooling. Air flow is front to rear, and the rear of the power supply module and the housing are slotted to exhaust heat.

Figure 1.3.5 shows a front view of a power supply module and a detail view of the label. The upper right corner of the label shows the rated output wattage of the power supply module. The additional information on the label includes the part number and the serial number.

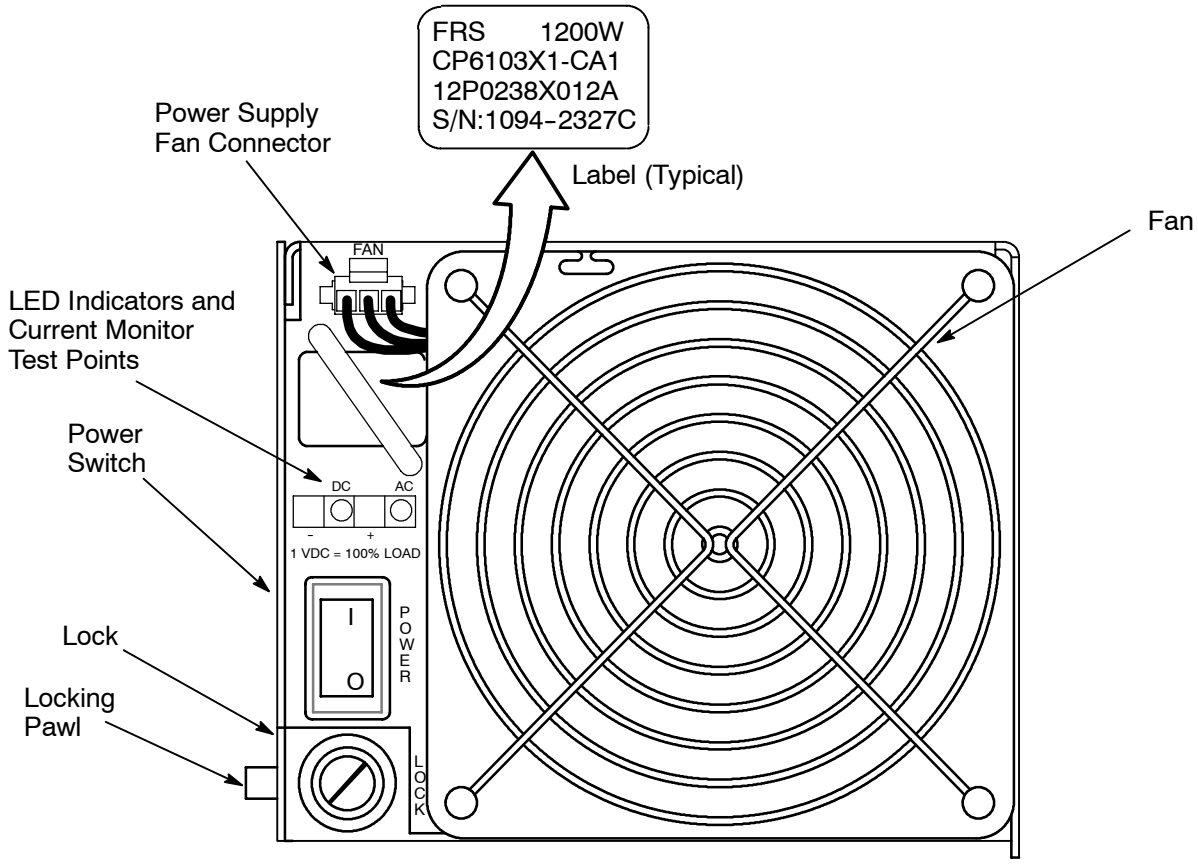


Figure 1.3.5. Power Supply Module

Electrical Description

Each power supply module converts AC line voltage to the DC voltage required by the equipment and field instruments. The power supply module output is rated at 1200 watts. The switching power supplies have universal AC inputs with power factor correction and can operate over an input range of 85–264 VAC, 47–63 Hz without reconfiguration. However, this supply voltage will be passed through auxiliary output, so AC voltage ranges for auxiliary devices (cabinet fans) must be properly defined. The power supply module outputs are provided with overvoltage, overcurrent, and short circuit protection.

A pair of isolated test jacks on the front of each power supply module enable monitoring of output current.

Each power supply module has two front-mounted LEDs:

- The amber LED indicates that the power supply module's AC input is energized.
- The green LED indicates that the DC output voltage is within tolerances.

Each power supply module has an alarm relay that connects to a terminal block on the power supply housing. Alarm relays are energized during normal operation and de-energized if the DC output is out of tolerance or if the cooling fan fails. The alarm relay contacts are rated to 5 amperes at 250 VAC, or 5 amperes at 30 VDC, for a resistive load. A current-limited interlock loop (limited to 100 mA) is provided to allow connection of other external alarm circuits. See *Alarm Wiring* on page 1-3-11 for more information.

The power supply housing includes separate AC input terminal blocks for each power supply module, enabling each power supply module in a housing to be connected to a separate AC source.

Inputs from each terminal block are routed through a single-pole, 15-ampere circuit breaker to an auxiliary AC output terminal block that can be used to power auxiliary equipment such as cabinet fans.

Individual power supply modules can be removed from the power supply housing and replaced without interrupting power to equipment that is redundantly powered.

You must power up multiple power supply modules connected to the same DC Distribution Bus consecutively, all within approximately 2–3 seconds. If too much time elapses between the power-up of the first and last power supply modules, one or more of the modules may go into over-current mode, until together they are able to supply the load.

Planning

The system power supply housing fits on standard 483 mm (19 in.) EIA rails in front-access system cabinet assemblies and occupies three units of vertical rack space. Outline dimensions of the housing are shown in Figure 1.3.1.

This section provides information on using System Power Supply Units in a typical RS3 system cabinet installation.

System Cabinet and AC Wiring

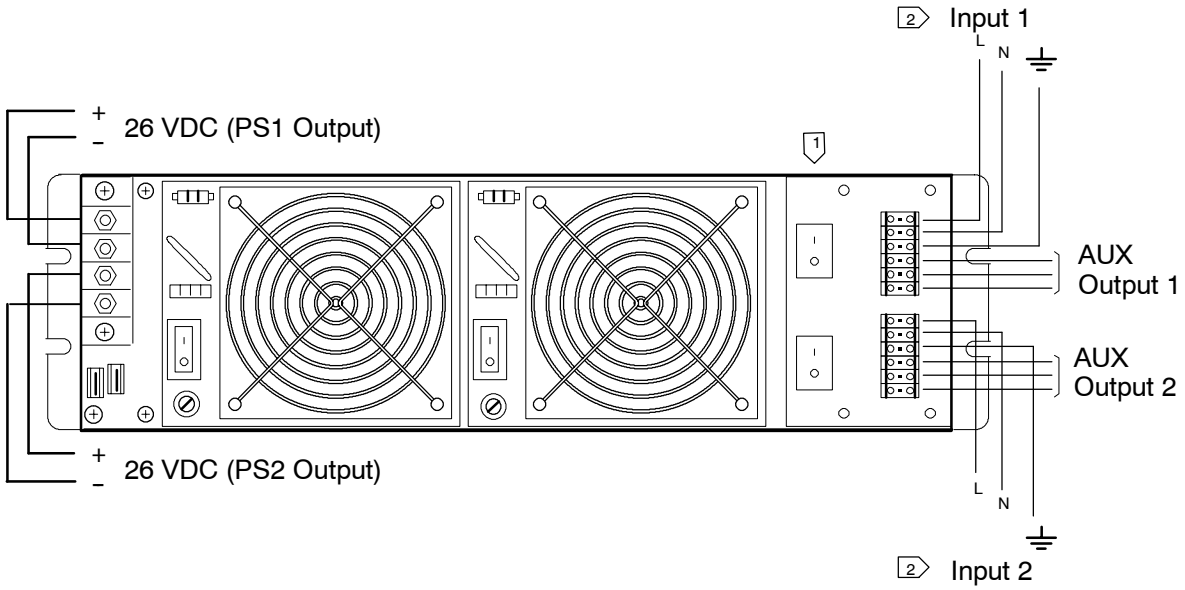
You will need to provide AC power to the system cabinets from an external circuit breaker panel, and wire the power leads to the AC input terminal blocks on the power supply housing. Use wire with insulation rated at least twice the working voltage of the circuit.

Fisher-Rosemount Systems recommends that each 1200-watt power supply module be powered from a 30-ampere circuit breaker. In no case should a power supply module be powered from a circuit breaker larger than 30 amperes.

Each power supply housing contains one or two power supply modules as shown in Figure 1.3.6. Terminal blocks are provided for two AC input sources. This enables each power supply module in the housing to be connected to a separate AC source. The chassis of the power supply housing is internally bonded to the ground terminal of each AC input terminal block.

Inputs from each terminal block are routed through a single-pole, 15-ampere circuit breaker to a terminal block for use by auxiliary equipment such as fans.

NOTE: The cabinet fans used with the RS3 System Power Supply Units are not autosensing. Depending on the AC input (110 VAC or 220 VAC), the correct fan must be specified according to the input voltage. AC power is supplied to the AC fan in the RS3 system cabinet from the auxiliary outputs on the RS3 System Power Supply Unit. (System cabinets use an AC fan. RMP cabinets use a DC fan.)



Notes:

1 Rocker ON/OFF switch/circuit breaker for auxiliary AC outputs
2 Input 1 and Input 2 shall be supplied from separate dedicated circuit breakers

Figure 1.3.6. System Cabinet DC Output Terminals

System Cabinet DC Power Configurations

System Power Supply Units are intended to operate in an N+1 redundancy configuration. There should always be one extra power supply module connected to a DC bus to provide redundancy. Separate DC output terminals are provided for each power supply module on the front of the housing, as shown in Figure 1.3.6.

Standard RS3 system cabinets are available with cable entry openings in both the top and bottom panels. The System Power Supply Unit and DC Distribution Bus can be mounted as appropriate for bottom cable entry or top cable entry.

A typical system might have three cabinets, with three primary supplies and one redundant supply. The redundant supply is normally load sharing with the primary supplies. If a primary or redundant supply fails, there will be no power loss at the load. No. 8 AWG insulated wire, orange for 26V+ and brown for 26V–, is used to connect the System Power Supply Unit DC outputs to the DC Distribution Bus. Use either the 1-meter cable (10P58277001) or the 3-meter cable (10P58277003) to make this connection. Do not exceed 2.15 + 0.12 N•m (19+1 lbf•in) torque on the DC output terminals of the System Power Supply Unit.

Use separate wire channels for high-voltage (110/220 VAC) lines and low-voltage (4–20 mA) signal lines to maintain as much separation as possible between voltage and signal wiring. A minimum of 203 mm (8 in.) is recommended.

Jumpers on the ControlFile Power Regulator and OI Power Regulator must be set for 24 VDC, as follows:

Regulator	Header	Position
OI Power Regulator	HD1	2–3
ControlFile Power Regulator	HD1	1–2

Refer to the *Site Preparation and Installation Manual* (SP) for more information about system cabinet configurations, dimensions, grounding, etc.

The DC power distribution system consists of a DC Distribution Bus (installed in the system cabinet), DC Output card (attached to the DC Distribution Bus), and various cables.

Each DC Distribution Bus assembly within a system cabinet consists of three copper bus bars with a current-carrying capacity of 200 amperes. DC Distribution Bus assemblies can be daisy chained as required, using a Jumper Cable DC bus to DC bus (1984–0373–xxxx). Bus A is normally jumpered to bus B, giving a bus A/B.

A standard, non-redundant, DC power distribution system consists of one or more System Power Supply Units feeding one or more DC Distribution Bus assemblies. Figure 1.3.7 shows a standard bus A/B operation.

A DC Distribution Bus should have no more than two System Power Supply Units (four DC outputs) wired to it, redundant power supplies included. This applies to both redundant and non-redundant buses.

NOTE: If a single System Power Supply Unit is used, the configuration should be the standard A/B distribution as shown in Figure 1.3.7.

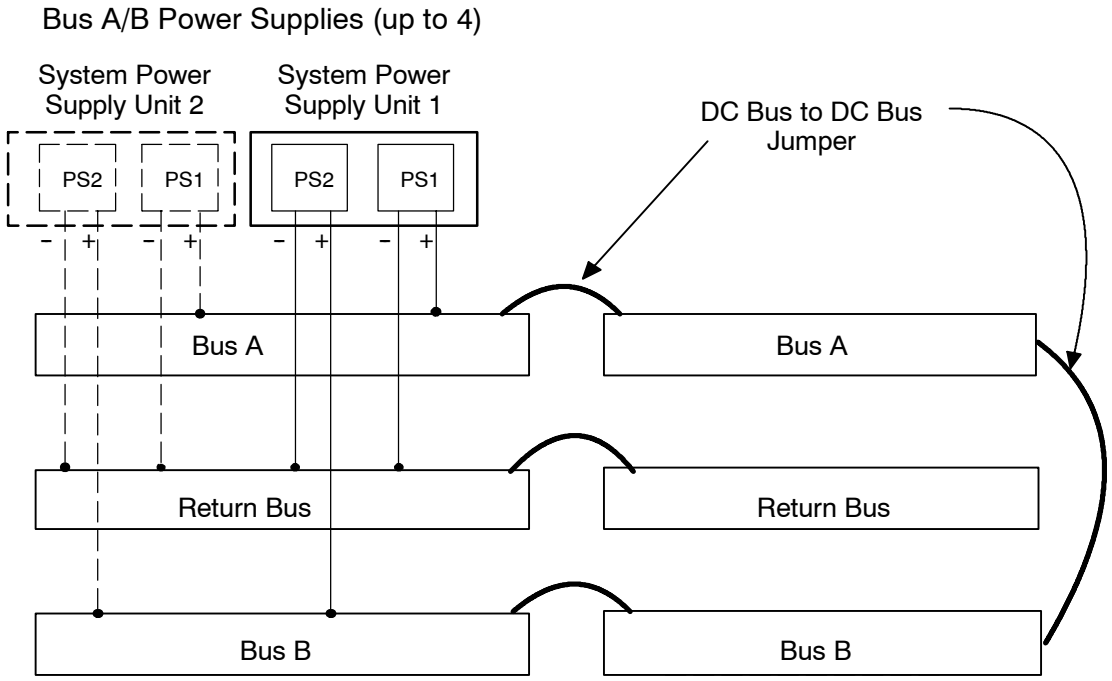


Figure 1.3.7. Standard DC Power Distribution for System Power Supply Units

Figure 1.3.8 represents a redundant DC power distribution configuration consisting of one System Power Supply Unit feeding bus A and another System Power Supply Unit feeding bus B. Buses A and B are not connected.

Each bus (A and B) needs to have a separate redundant power supply module, so a total of two redundant power supply modules are needed for a redundant DC power distribution. (This would be a redundant bus/redundant power supply configuration, which meets the N+1 redundancy requirement.)

The redundant bus configuration must have the same number of power supply modules on each bus. Four power supply modules (two Power Supply Units) is the maximum allowed for both buses.

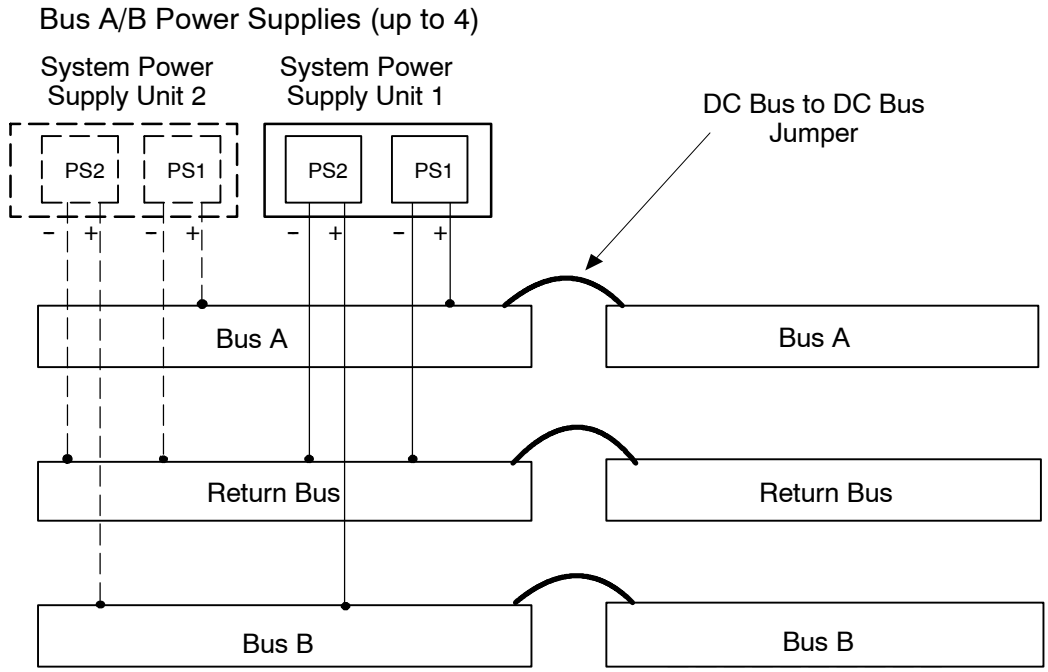


Figure 1.3.8. Redundant DC Power Distribution System for System Power Supply Units

Alarm Wiring

Figure 1.3.9 shows the alarm connections on the housing. The housing contains separate alarm connections for each power supply module. The alarm and interlock terminal blocks connect to alarm relay contacts and interlocks in the power supply modules. The alarm terminal blocks do not require wire terminating lugs.

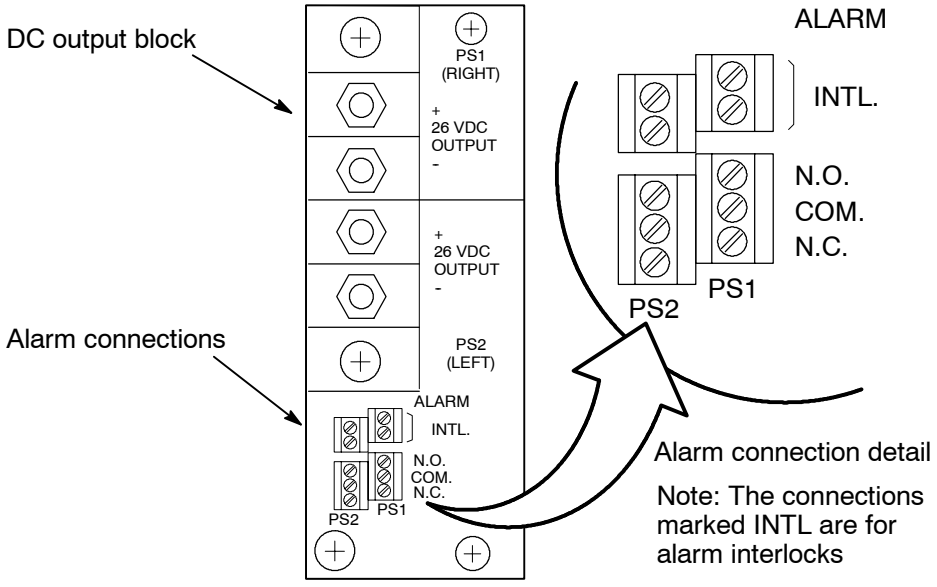


Figure 1.3.9. Alarm Connections

To cause either power supply module relay to function as a combined alarms relay, connect any number of external alarm contacts that are closed during normal equipment operation in series and wire them across the interlock terminal connection of the power supply module. Refer to Figure 1.3.10 for an example.

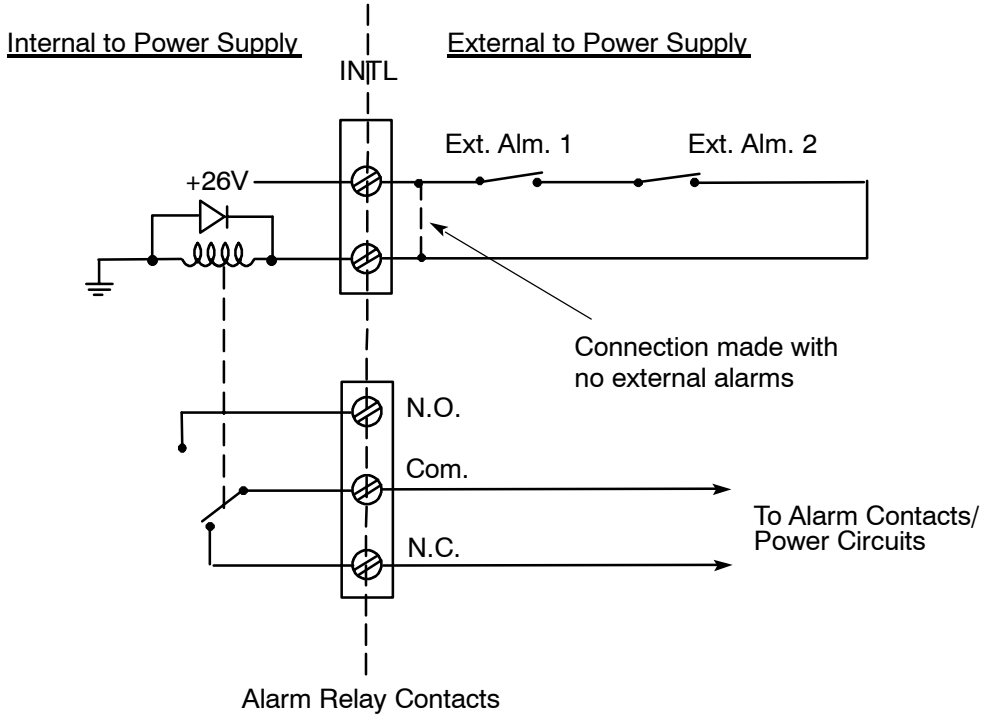


Figure 1.3.10. Alarm Connection Example

If the interlock connections of an installed power supply module are not connected to external alarm contacts, jumper the connections to enable the power supply module alarm relay to operate properly.

To use only one combined alarm for a cabinet, wire the output alarm contacts for one power supply module into the interlock circuit of the other power supply module.

Alarm relay contacts are rated to 250 VAC. Use wiring with insulation rated at least 300 Volts or twice the working voltage used for these circuits, whichever is higher. Use 2.07 mm^2 (14 AWG) to 0.812 mm^2 (18 AWG) wire for the connection.

Special Conditions

Ensure that all other devices are mounted above the Operator Interface (OI) electronics to ensure compliance with temperature requirements. The OI must be the lowest device mounted in a system cabinet.

Installation

The typical factory-prepared cabinet installation is shipped with the System Power Supply Unit mounted. However, this section provides installation procedures in the event you need to install a System Power Supply Unit.

Physical Installation

This subsection explains how to:

- Install a power supply housing in a cabinet
- Install a power supply module in a housing.

Installing a Housing in a Cabinet

Fisher-Rosemount Systems recommends that you install the housing first, without power supply modules; then install the power supply modules in the housing.

NOTE: The System Power Supply Unit can weigh as much as 13.29 kg (29.3 lb) if two power supply modules are installed.

The following procedure describes installation of a power supply housing in a system cabinet.

1. Place all external circuit breakers that control AC power inputs to the power supply housing in the OFF position.

CAUTION

The DC Distribution Bus and associated power cables may have DC power still applied if the load is backed up by a redundant power source located elsewhere. Personal injury and equipment damage can occur if a DC Distribution Bus or cable is accidentally shorted. Turn off any backup power sources.

2. Position the power supply housing on the EIA rails. Provide sufficient support to hold the housing in place until the flange-lock screws are installed and tightened.
3. Install the four M6 Phillips Screws with nylon splash (G12215-2006-0116) and M6 cage nuts (G53426-0601-0716) and tighten them until the housing is securely attached to the cabinet rails.

4. Connect DC output and alarm wiring as required for your installation.
5. Connect the AC inputs to the input terminal blocks on the right side of the housing front panel.
6. Install power supply modules in the housing (see *Installing a Power Supply in a Housing*, following).
7. After following appropriate procedures for energizing circuits, place all circuit breakers that control cabinet AC power in the ON position.

NOTE: Be sure to place the startup voltage jumpers on the OI and ControlFile power regulators in the 24 Volt position when using a System Power Supply Unit.

Installing a Power Supply in a Housing

The following procedure describes installation of a power supply module in the housing.

1. Ensure that the AC power switch on the front of the power supply module is in the off (O) position and that the locking pawl is in the horizontal position.
2. Align the power supply module with the guide rails in the housing.
3. Slide the power supply module into the housing, making sure that the bottom right edge of the power supply module engages the plastic guide rail in the housing.

   NOTE: If you are installing only one power supply module in a housing, install it in the right side of the housing.

4. Continue inserting the power supply module until the locking pawl reaches the stop.
5. Using a screwdriver, slowly turn the locking screw counterclockwise one quarter turn while observing the pawl to ensure that it freely rotates 90 degrees to the vertical position and engages the slot in the bottom of the housing.

   If the pawl does not rotate to the vertical position, move the power supply module in or out of the housing slightly to align the pawl with the slot in the housing.
6. Turn the locking screw approximately 10 additional turns counterclockwise until it stops, to fully seat the blind-mate connector. The remaining turns draw the power supply module into the housing and seat the blind-mate electrical connector.

CAUTION

Do not apply power to the power supply module until the blind-mate connector is fully seated. Failure to fully seat the connector may result in damage to the power supply module and power supply housing.

Using the Auxiliary AC Outputs

The power supply housing includes two auxiliary AC outputs that are independent of the power supply modules. Figure 1.3.11 shows the layout of the AC input and auxiliary output terminal blocks and circuit breakers.

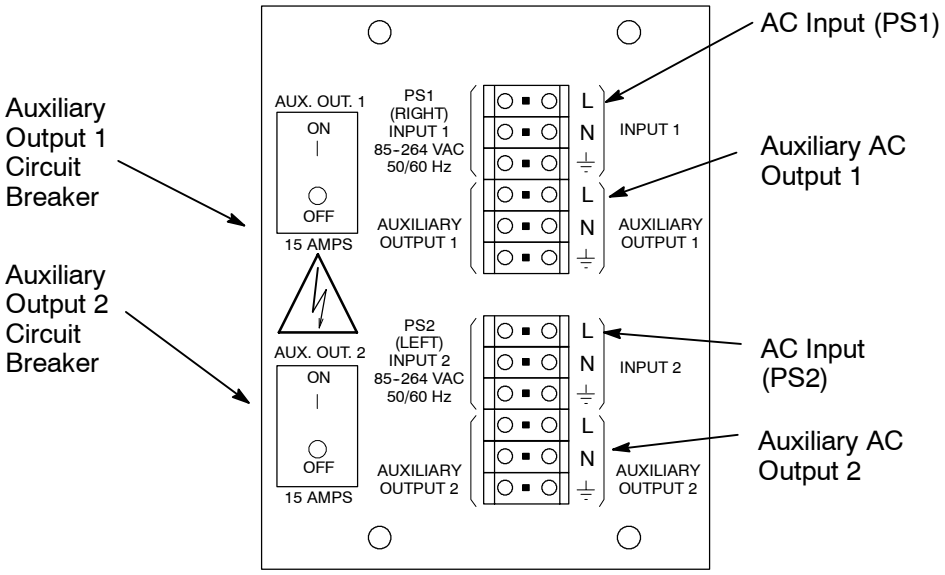


Figure 1.3.11. Input and Auxiliary Output Connectors and Auxiliary Output Circuit Breakers

Figure 1.3.12 shows a schematic diagram for one set of AC inputs and auxiliary AC outputs. Each housing has two identical circuits, one for each power supply module. Note that the circuit breakers on the housing control only the auxiliary AC outputs and do not control power to the power supply modules. Use wire with insulation rated for a minimum of twice the rated mains supply voltage that feeds the auxiliary circuit.

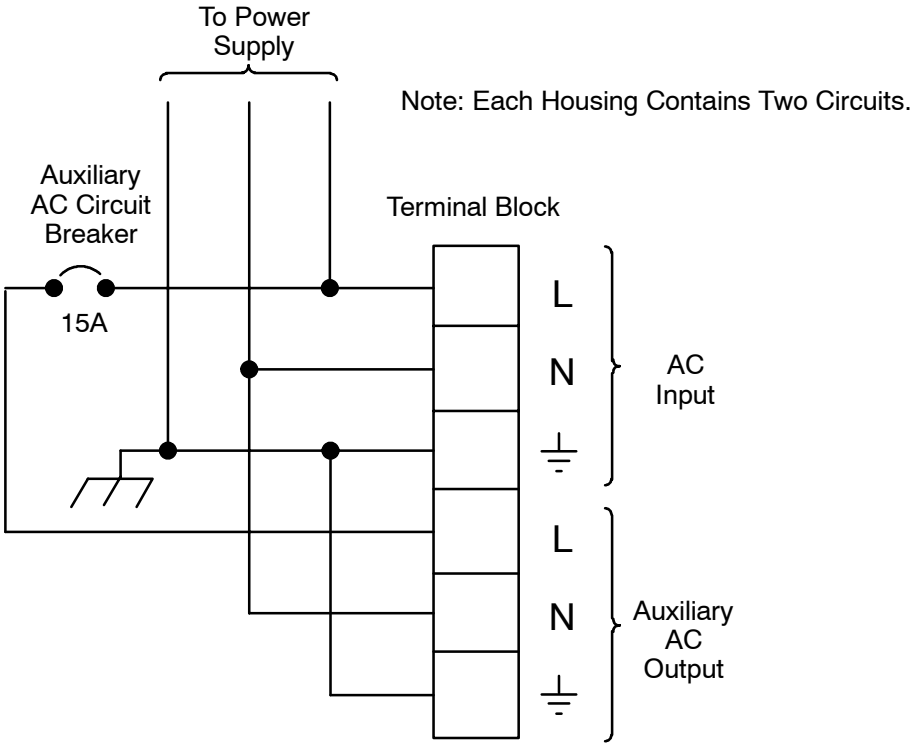


Figure 1.3.12. Power Supply Housing AC Input and Auxiliary AC Output Schematic Diagram

Maintenance

Maintenance requirements for the System Power Supply Unit are described in the following subsections.

General Maintenance

Each power supply module has test points for monitoring the current output. The test point voltages serve as an indicator and are not an absolute measure of a power supply module's output.

Replacing a Cooling Fan

The only regular maintenance required for the System Power Supply Unit is replacing the cooling fans on the power supply modules. The recommended maintenance interval for replacing the fan is 3.5 years (42 months). For fan replacement, you will need a replacement fan kit (12P0239X012).

CAUTION

Fan replacement at recommended intervals is necessary because a fan failure causes the power supply module to shut down which may cause critical control equipment to lose power.

To replace a cooling fan (see Figure 1.3.13):

1. Remove the power supply module from the housing to gain access to the plastic rivets that connect the fan to the power supply module. *(See "Removing a Power Supply from a Housing.")*
2. Disconnect the fan power connector from the power supply module.
3. Using a small screwdriver or other suitable tool, pry the pin out of the plastic rivets at each corner of the fan and remove the fan.

   There are two sets of rivets: four that hold the fan to the power supply module and four that hold the fan grill to the fan. Because the fan and grill are removed as a unit, only the rivets that hold the fan to the power supply module must be removed.

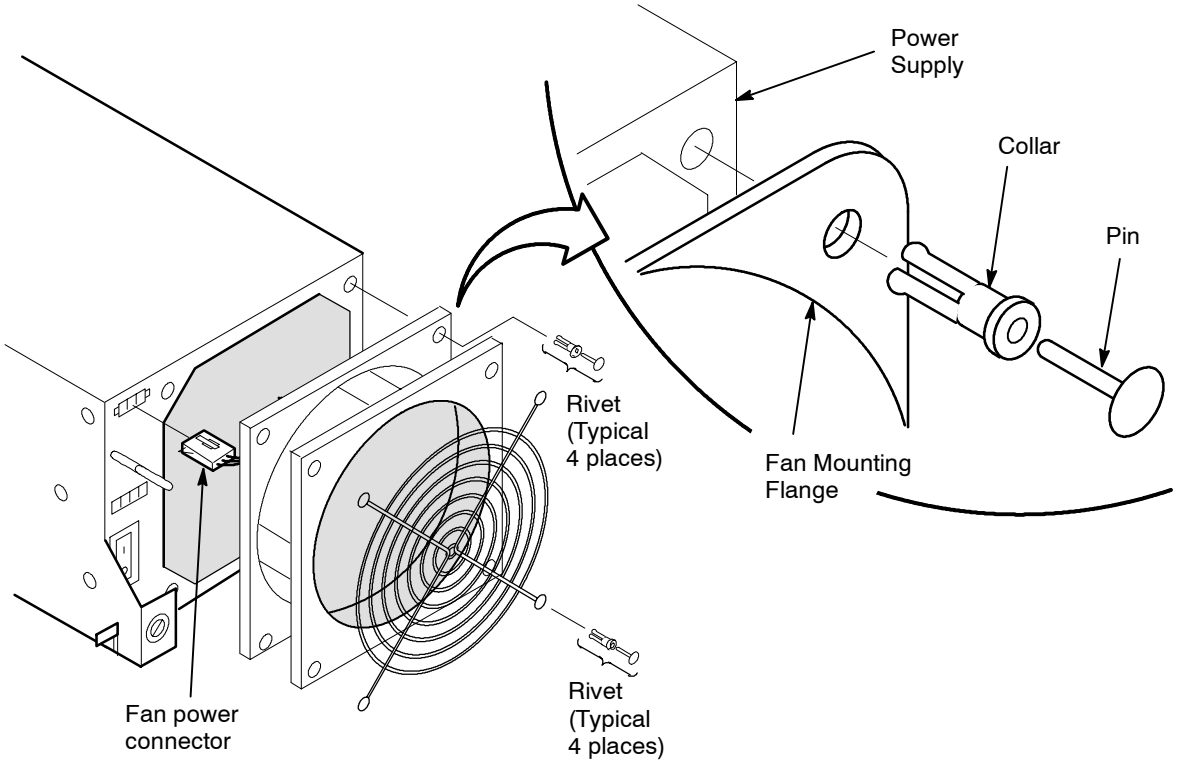


Figure 1.3.13. Replacing the Fan and Grill in a Power Supply

4. Remove the fan from the power supply module.
5. Position the new fan on the power supply module.
6. At each fan mounting hole, insert a plastic collar until the lip of the collar seats on the fan. Use a new collar from the replacement fan kit.

7. Press a plastic pin into the collar until it seats on the collar flange. This expands the collar to hold the fan to the power supply module.
8. Position the new grill from the replacement fan kit on the fan.
9. At each grill mounting hole, insert a plastic collar until the lip of the collar seats on the grill. Use a new collar from the replacement fan kit.
10. Press a plastic pin into the collar until it seats on the collar flange. This expands the collar to hold the grill to the fan.
11. Connect the fan power connector to the power supply module.
12. Install the power supply module in the housing following the steps in *Installing a Power Supply in a Housing.*

Replacing a Power Supply

To remove and replace a power supply module, follow the procedures below.

The housing and power supply modules can be removed from a cabinet as a unit; however, removing the power supply modules from the housing first makes the housing lighter and easier to handle.

NOTE: System Power Supply Units cannot be used in a redundant bus scheme with AC/DC power supplies.

NOTE: Because of the wide variety of existing installations, it is not possible to include procedures for replacing an AC/DC power supply and AC entrance panel with a System Power Supply Unit. If your installation requires such a change, consult with your Fisher-Rosemount Systems representative or sales office for assistance.

Removing a Power Supply Housing from a System Cabinet

To remove a power supply housing from a system cabinet:

1. Place all external circuit breakers that control AC power inputs to the power supply housing in the OFF position.
2. After initiating an approved lockout procedure, disconnect the AC input or inputs from the terminal blocks on the right side of the housing and disconnect any wiring to auxiliary outputs.
3. Disconnect the DC outputs and alarm wiring from the terminals on the left side of the housing. Note that the DC power cables and associated cabinet bus bars could still be powered if the load is backed up by a redundant power source located elsewhere. The alarm wiring could also be powered by an external source. If in doubt, measure all terminals before disconnecting wiring.

4. Remove the power supply modules from the housing, if desired:
   a. Make sure the AC power switch on the front of the power supply module is in the off (O) position.
   b. Using a screwdriver, turn the locking screw clockwise until the locking pawl rotates to the horizontal position.
   c. Using the handle on the front of the power supply module, pull the power supply module out of the housing.
5. Provide sufficient support for the housing to prevent it from dropping. (If the two power supply modules have not been removed from the housing, the System Power Supply Unit can weigh as much as 13.29 kg (29.3 lb).)
6. Remove the four M6 Phillips Screws and M6 cage nuts securing the power supply housing to the rails of the cabinet. Retain the screws and nuts for reinstallation of the power supply housing.

CAUTION

The DC Distribution Bus and associated power cables may have DC power still applied if the load is backed up by a redundant power source located elsewhere. Personal injury and equipment damage can occur if a DC Distribution Bus or cable is accidentally shorted. Turn off any backup power sources.

Installing a Housing in a Cabinet

Fisher-Rosemount Systems recommends that you install the housing first, without power supply modules, then install the power supply modules in the housing. The System Power Supply Unit can weigh as much as 13.29 kg (29.3 lb) if two power supply modules are installed.

To install a power supply housing in a system cabinet:

1. Place all external circuit breakers that control AC power inputs to the power supply housing in the OFF position.

CAUTION

The DC Distribution Bus and associated power cables may have DC power still applied if the load is backed up by a redundant power source located elsewhere. Personal injury and equipment damage can occur if a DC Distribution Bus or cable is accidentally shorted. Turn off any backup power sources.

2. Position the power supply housing on the EIA rails. Provide sufficient support to hold the housing in place until the flange-lock screws are installed and tightened.

3. Install the four M6 Phillips Screws and M6 cage nuts and tighten them until the housing is securely attached to the cabinet rails.
4. Connect DC output and alarm wiring as required for your installation.
5. Connect the AC inputs to the input terminal blocks on the right side of the housing front panel.
6. Install power supply modules in the housing if they are not already installed. (See *Installing a Power Supply in a Housing*, following.)
7. After following appropriate procedures for energizing circuits, place all circuit breakers that control cabinet AC power in the ON position .

Installing a Power Supply in a Housing

To install a power supply module in the housing:

1. Ensure that the AC power switch on the front of the power supply module is in the off (O) position and that the locking pawl is in the horizontal position.
2. Align the power supply module with the guide rails in the housing.
3. Slide the power supply module into the housing, making sure that the bottom right edge of the power supply module engages the plastic guide rail in the housing.

NOTE: If you are installing only one power supply module in a housing, install it in the right side of the housing.

4. Continue inserting the power supply module until the locking pawl reaches the stop.
5. Using a screwdriver, slowly turn the locking screw counterclockwise one quarter turn while observing the pawl to ensure that it freely rotates 90 degrees to the vertical position and engages the slot in the bottom of the housing.

   If the pawl does not rotate to the vertical position, move the power supply module in or out of the housing slightly to align the pawl with the slot in the housing.
6. Turn the locking screw approximately 10 additional turns counterclockwise until it stops, to fully seat the blind-mate connector. The remaining turns draw the power supply module into the housing and seat the blind-mate electrical connector.

CAUTION

Do not apply power to the power supply module until the blind-mate connector is fully seated. Failure to fully seat the connector may result in damage to the power supply module and power supply housing.

Removing a Power Supply from a Housing

Individual power supply modules can be removed from a housing while the housing is installed in a cabinet or after the housing has been removed from a cabinet.

To remove a power supply module from the housing:

1. Make sure the AC power switch on the front of the power supply module is in the off (O) position.
2. Using a screwdriver, turn the locking screw clockwise until the locking pawl rotates to the horizontal position.
3. Using the handle on the front of the power supply module, pull the power supply module out of the housing.

Specifications

Table 1.3.1 contains the specifications for the System Power Supply Unit.

Table 1.3.1. System Power Supply Unit Specification

Item	Specification
Input Voltage	85 to 264 VAC, 47 to 63 Hz, single phase line-to-neutral. Internally fused. Undervoltage protected. Input power indicators.
Output Voltage	26.00 +/– 1.00 VDC, isolated from chassis, internal *OR-ing* diodes.
Output Power	1200 watts (46 amperes @ 26 VDC) at 60°C (140°F).
Auxiliary Output	Terminal blocks and circuit breakers for auxiliary AC output.
Leakage Current	3.5 mA maximum at 240 VAC, 60 Hz input.
Inrush	Soft start, 50 A peak maximum for one cycle or less at 240 VAC.
Power Factor	0.98 minimum at full load (meets EN 60555–2 harmonics limit).
EMC Compliance	Emissions: EN 50081–2 Immunity: EN 50082–2 Radiated Radio Frequency (RF), continuous wave, 20 to 1000 MHz at 35 V/m Radiated RF, 80% amplitude modulation of a 1 kHz sinewave, 20 to 1000 MHz at 35 V/m Radiated RF, pulsed with a 1 Hz square wave, 20 to 1000 MHz at 35 V/m Surge: Withstand ANSI/IEEE C62.41–1991 Category B3 transients (with output to remain within specified tolerance).

Table 1.3.1. System Power Supply Unit Specification (continued)

Item	Specification
Applicable Safety Standards	CSA-C22.2 No. 234-M90 CSA-C22.2 No. 142-M1987 CSA-C22.2 No. 1010.1-92 EN 60950 including Clause 2.3 EN 61010-1 UL 1950
Agency Approvals	NRTL/C certified, CE
Alarm Relay	Contacts rated at 5 A @ 30 VDC and 5 A @ 250 VAC.
Test Jacks	Monitor output current 0 to 100% of full load (0 to 1 VDC).
Holdup Time	20 ms minimum, output to remain within 5% of nominal at full load.
Parallel Operation	Up to 4 power supply modules, current share within 10%.
Overload Protection	Overload and short circuit protection, automatic recovery.
Thermal Protection	Shutdown on overtemp, automatic reset.
Overvoltage Protection	Output protected at 105 to 110%.
Reverse Voltage Protection	Protected to load rating.
Operating Temperature	0 to 70°C (32 to 158°F), rated wattage to 60°C (140°F), derating of 2.5%/°C above 60°C.
Storage Temperature	-67 to 185°F (-55 to 85°C).
Relative Humidity	5% to 95% non-condensing.
Airborne Contaminants	Designed for operation in environmental conditions per ISA-S71.04-1985 gaseous corrosion level G2.
Altitude	Sea level to 2440 meters (8000 feet) without derating.
Cooling Fan	Brushless, DC.
Reliability	200,000 hours MTBF minimum at 25°C (77°F).
Mounting	Rack mountable power supply housing with blind-mate connectors for power supply modules.
Dimensions	Overall housing: 483 mm (19 in.) wide x 133.4 mm (5.25 in.) high x 343 mm (13.5 in.) deep (from mounting flange).
Weight	Housing: 5.66 kg (12.5 lb). Power Supply Module: 3.81 kg (8.4 lb).

Section 4:
DC Power Distribution

This section describes the DC power distribution system and the DC Output card.

A standard, non-redundant, DC power distribution system consists of one or more AC/DC Power Supplies feeding one or more DC Distribution Bus assemblies as shown in Figure 1.4.1. Each DC Distribution Bus assembly consists of three 1 x 14 inch copper bus bars with a current carrying capacity of 200 amps. DC Distribution Bus assemblies may be daisy chained as required using DC Bus to DC Bus Jumper cables. Bus A is frequently jumpered to bus B giving bus A/B.

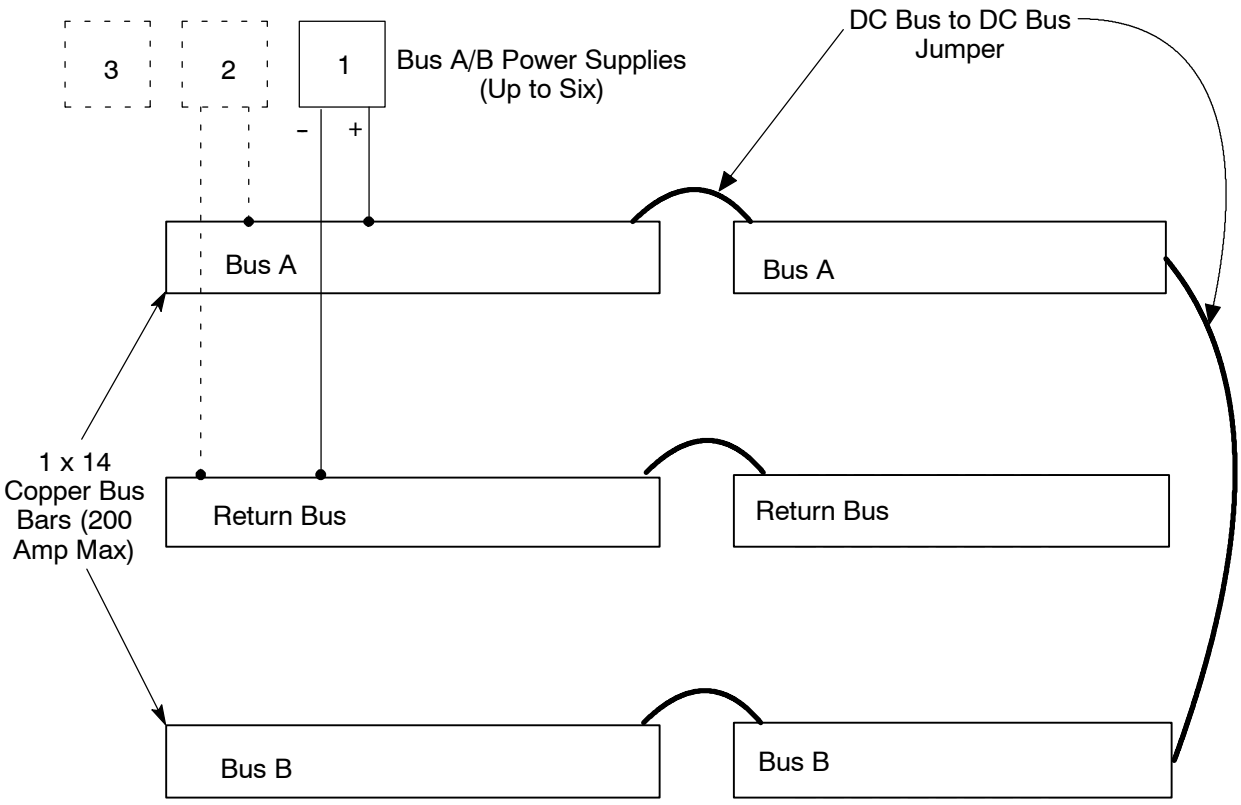


Figure 1.4.1. Standard DC Power Distribution System

A redundant DC power distribution system consists of one set of AC/DC Power Supplies feeding the bus A and another set of AC/DC Power Supplies feeding the bus B as shown in Figure 1.4.2. Buses A and B are not connected.

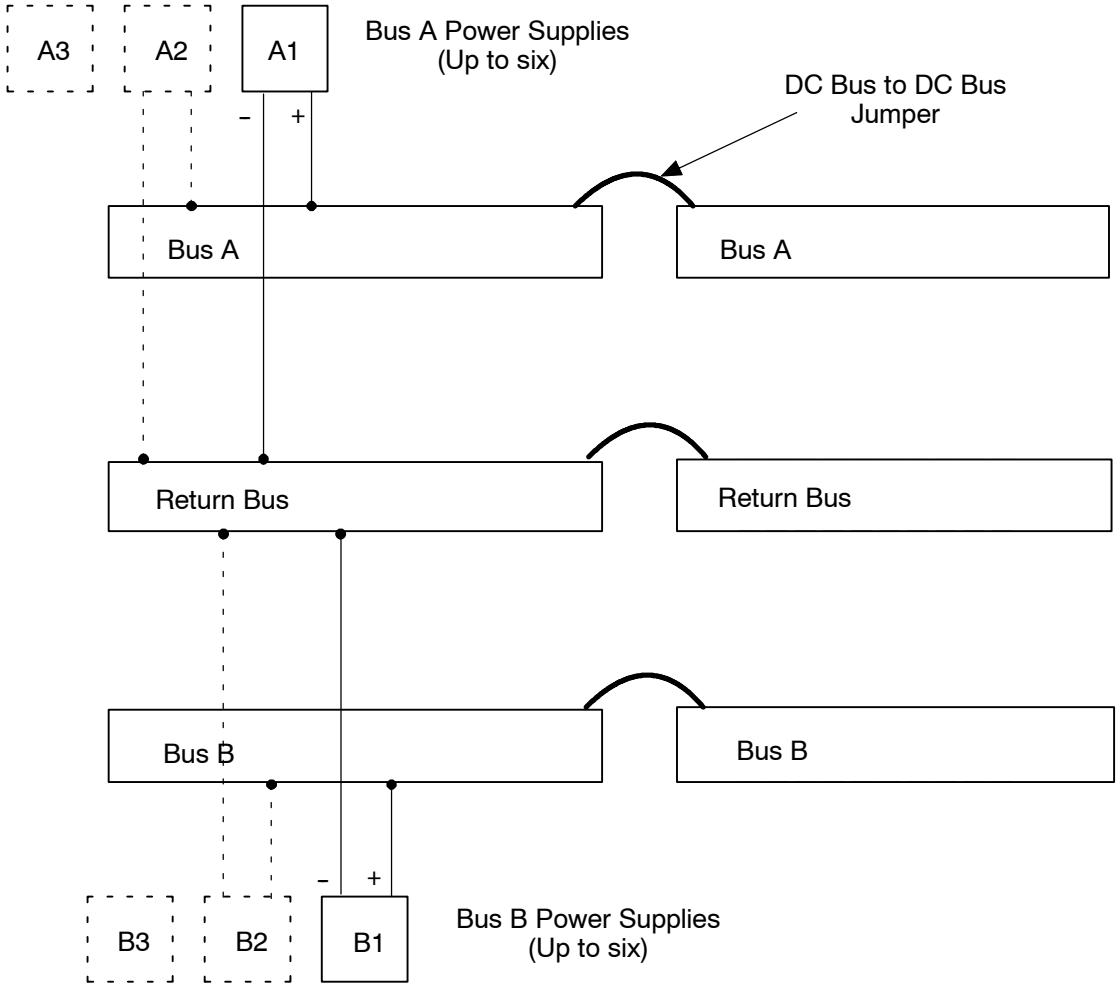


Figure 1.4.2. Redundant DC Power Distribution System

DC Power Distribution Bus

The DC Power Distribution Bus (1984-1144-000x) distributes power to consoles, ControlFiles, FlexTerms, card cages, and some field devices. Figure 1.4.3 shows a functional diagram of the DC Power Distribution Bus.

Each AC/DC Power Supply is connected to the DC Power Distribution Bus by the “AC/DC Power Supply to DC Bus Cable” (1984-0283-00xx).

The DC Power Distribution Bus consists of heavy copper terminals mounted directly on three bus bars, bus A, bus B, and the return bus. bus A, bus B, and the return bus run parallel to each other in a plastic channel. Bus B is intended for use with an optional redundant DC distribution system. The return bus is used to connect the DC return system to the chassis with a large wire connected from the bus bar to the chassis ground lug. This is the only connection point of the DC return system to ground.

DC Power Distribution Bus assemblies may be daisy chained using the DC Bus to DC Bus Jumper Cable (1984-0373-00xx) or 2-gauge wire. The current limit is 180 amps.

Each DC Power Distribution Bus assembly may hold up to six DC Output cards, which are used to supply power to individual card cages and devices.

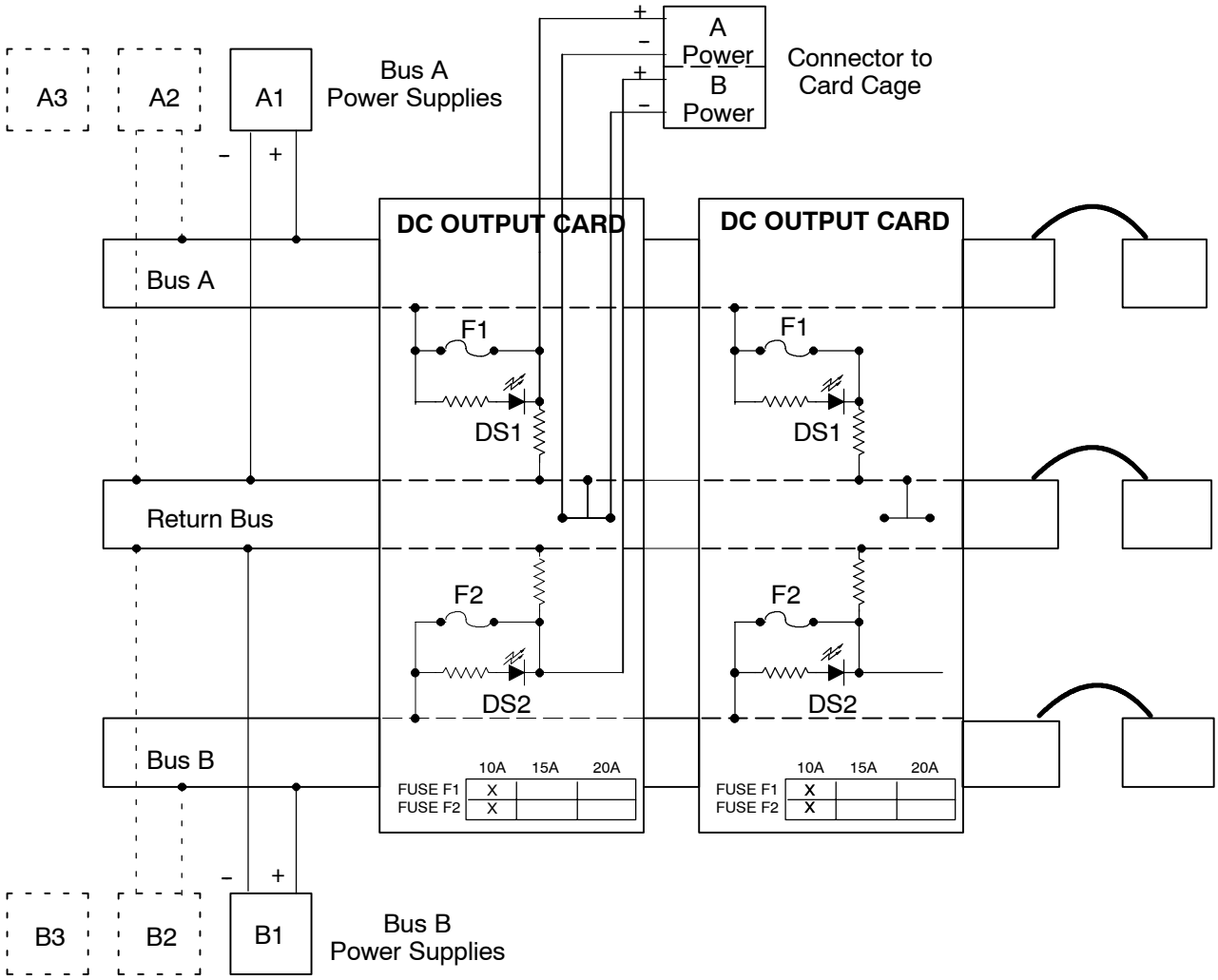


Figure 1.4.3. DC Power Distribution Bus

DC Output Card

Power for system devices is tapped from the bus bars by mounting DC Output cards (1984–1264–000x) on the bus bars as shown in Figure 1.4.4. The card is marked “DC OUTPUT” on the PWA.

Each DC Output card has a fuse and terminal for both bus A and bus B. An LED in parallel with each fuse lights to indicate a blown fuse. A fuse reference chart at the bottom of each output card indicates the proper size of fuse to be used in each position.

A standard DC distribution system has buses A and B jumpered together to give bus A/B. Devices may take power from either the bus A or the bus B portion of the DC Output card. Up to 12 devices may be connected to a single DC Distribution Bus in standard configuration.

A redundant DC distribution system has separate buses A and B. Up to six devices may be powered from a single DC Distribution Bus in the redundant configuration. Each device draws power from the bus A and the bus B portion of the DC Output card. Bus A and bus B fuses must be identical.

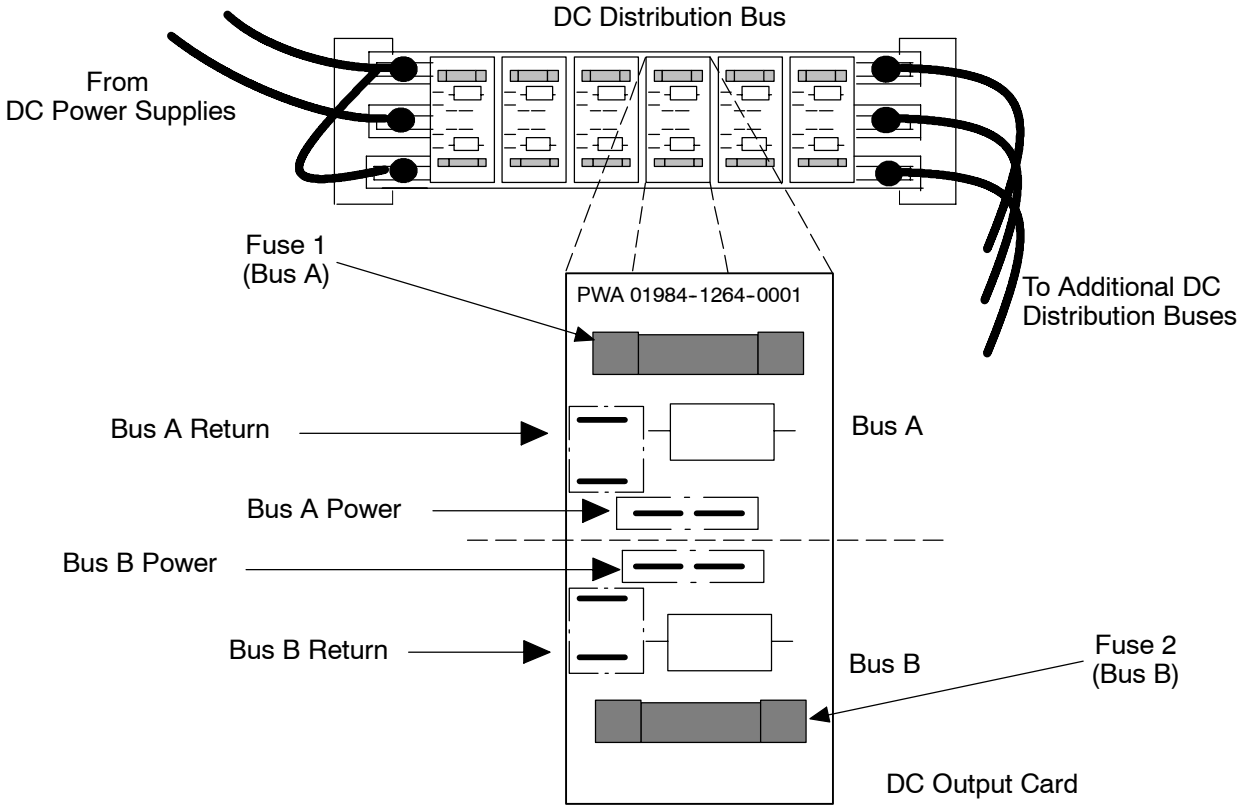


Figure 1.4.4. DC Distribution Bus and DC Output Card

DC Output Card Fuses

Table 1.4.1 shows the DC Output card fuses for various hardware devices.

Table 1.4.1. DC Output Card Fuses

Device	FRSI Part No.	Bussman Part No.	Littelfuse Part No.	Characteristics
Multitube Command ConsoleL 1 Tube	G09140-0047	AGC 15	311015	15 A 32 V Regular
Multitube Command ConsoleL 2 Tubes	G09140-0061	ABC 20	314020	20 A 250 V Regular
Multitube Command ConsoleL 3 Tubes	G09140-0061	ABC 20	314020	20 A 250 V Regular
Command Console	G09140-0047	AGC 15	311015	15 A 32 V Regular
MiniConsole	G09140-0047	AGC 15	311015	15 A 32 V Regular
ControlFile	G09140-0061	ABC 20	314020	20 A 250 V Regular
ControlFile Fan	G09140-0046	AGC 10	311010	10 A 32 V Regular
I/O Card Cage	G09140-0047	AGC 15	311015	15 A 32 V Regular
FlexTerm	G09140-0046	AGC 10	311010	10 A 32 V Regular
Highway Interface Adapter (HIA)	G09140-0047	AGC 15	311015	15 A 32 V Regular
Supervisory Computer Interface (SCI)	G09140-0047	AGC 15	311015	15 A 32 V Regular
System Manager Station (SMS)	G09140-0047	AGC 15	311015	15 A 32 V Regular
RS3 Network Interface (RNI)	G09140-0046	AGC 10	311010	10 A 32 V Regular
Multipoint I/O Term Panels	G09140-0046	AGC 10	311010	10 A 32 V Regular
Fiber Optic I/O Converter	G09140-0046	AGC 10	311010	10 A 32 V Regular

DC Distribution Cabling

The DC power distribution system may be:

- Standard, with bus A jumpered to bus B.
- Redundant, with bus A and bus B independently powered.

Standard DC Distribution Cabling

The Bus A/B DC Power Distribution Cable (1984-0158-20xx) is used on the Analog Card Cage, and on the Analog, Contact, MUX, and PLC FlexTerms. This cable allows upgrade to redundant DC power without adding another cable.

When using the Bus A/B DC Power Distribution Cable with a standard DC power system, attach it to the DC Output card as shown in Figure 1.4.5. Connection may be made to either the bus A or bus B portion of the card. The other portion of the card may be used for another device.

NOTE: The Pxxx tags on the cable will not match the Jxxx tags on the DC Output card.

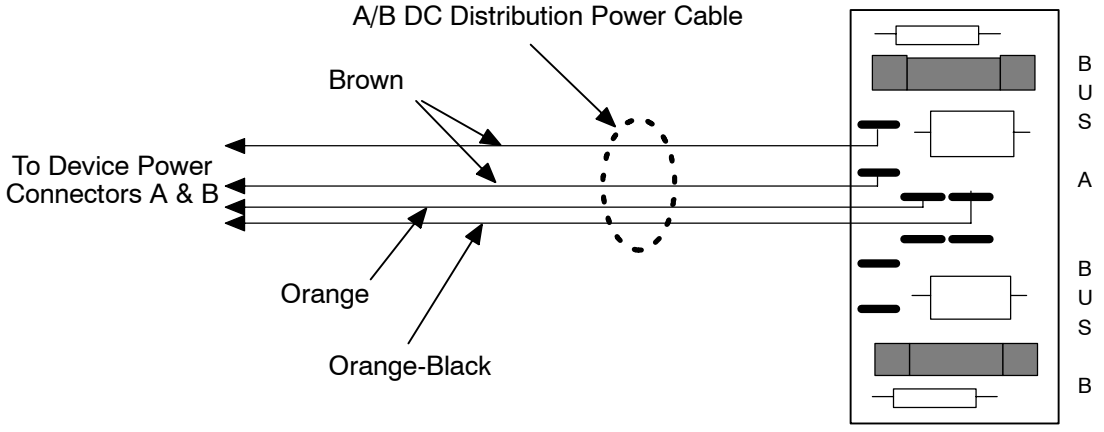


Figure 1.4.5. Non-redundant DC Power Cable

Redundant DC Power Distribution Cabling

When using bus A/B DC Power Distribution Cable with a redundant DC power system, attach it to the DC Output card as shown in Figure 1.4.6. This applies to all devices in which a single power cable can carry the load.

NOTE: The fuses in the sides of the output card of buses A and B must be identical.

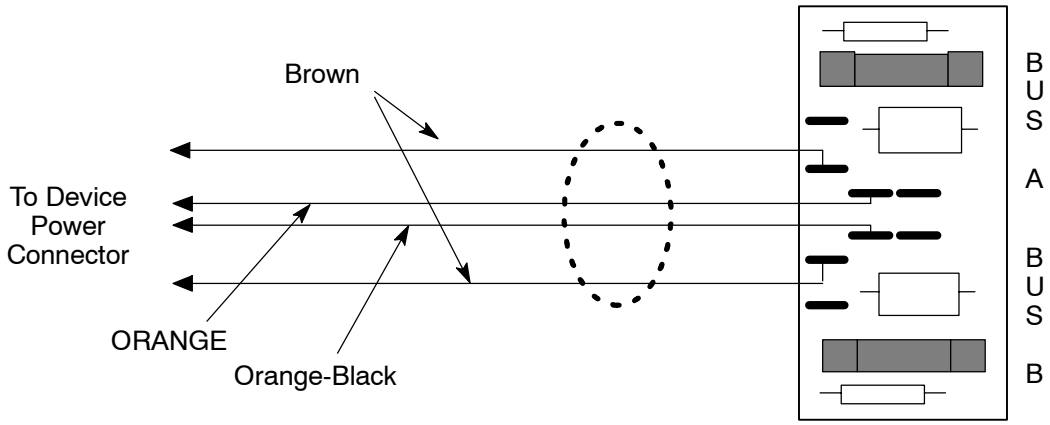


Figure 1.4.6. Redundant DC Power Cable

NOTE: The Pxxx tags on the cable will not all match the Jxxx tags on the DC Output card. See Table 1.4.2

Table 1.4.2. Power Cable Plugs and Jacks

Cable Plug	Jack
P233/4	J234
P235/6	J236
P237/8	J237
P239/40	J240

Bus A DC Power Distribution Cable (1984-0158-00xx) and bus B DC Power Distribution Cable (1984-0158-10xx) are used as dual power cables for the ControlFile, and the Multitube because a single redundant power cable (as in Figure 1.4.6.) cannot carry the load.

They are connected to the DC Output card as shown in Figure 1.4.7.

NOTE: The Pxxx tags on the cable will match the Jxxx tags on the DC Output card.

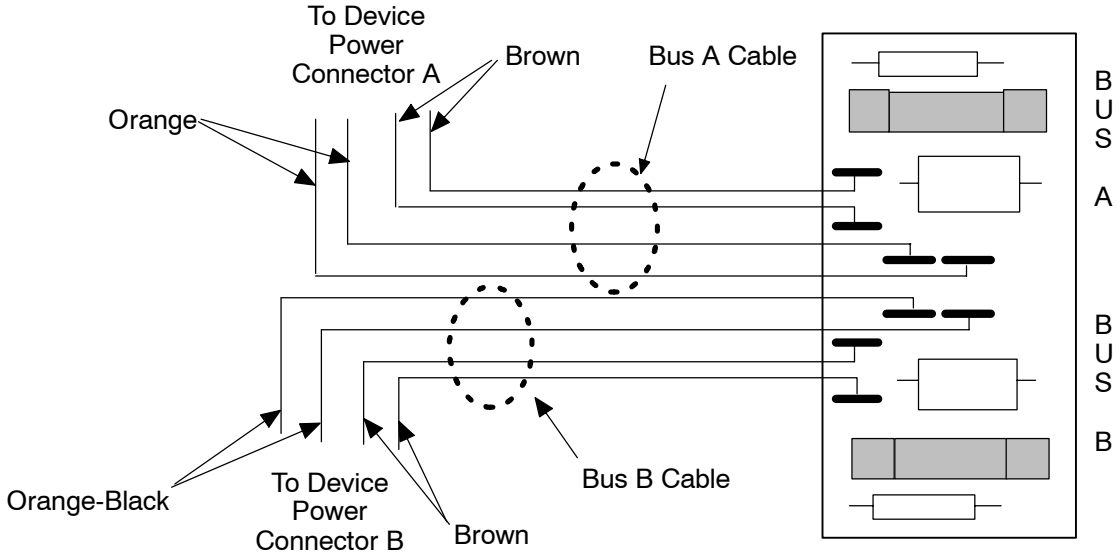


Figure 1.4.7. Dual DC Power Cables

NOTE: The fuses in the sides of the output card of buses A and B must be identical.

DC Power Distribution System Color Codes

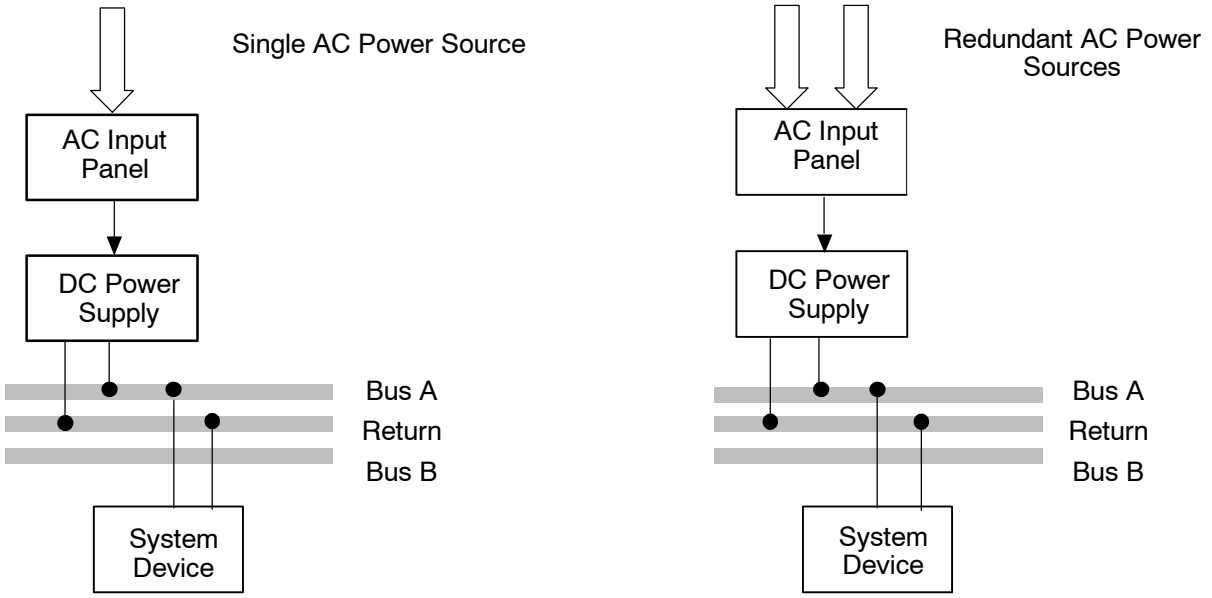
Table 1.4.3 shows the standard color codes used for DC wiring throughout the system.

Table 1.4.3. Standard Color Codes for Wiring and Test Points

Color	Voltage
Orange	+30 VDC
Brown	Ground Return
Red	+12 VDC
Blue	–12 VDC
Yellow	+5 VDC
Purple	+9 VDC (Unregulated) **NOTE:** Violet is used for test points on the –2494 Analog Transfer Card
White	+5 V Relative Current Indication
Green	+12 V Relative Current Indication
Gray	Isolated Ground Return

Section 5:
Redundant Power

This section shows different ways in which system power can be made redundant. Figure 1.5.1 shows examples of single and redundant system power. With single-source AC Power (no redundancy), if the AC power source fails, the system fails. With redundant AC Power, if one AC power source fails, the system relies on the second AC power source.



Single-Source AC Power **Redundant AC Power**

Figure 1.5.1. Examples of Redundant System Power

Figure 1.5.2 adds redundant power supplies. The DC power supplies share the load. If one DC power supply fails, the other DC supply assumes the load.

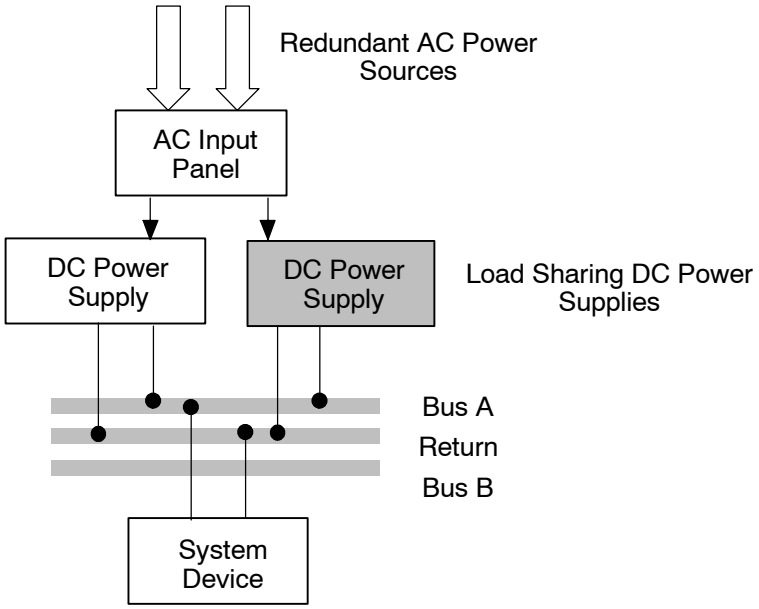


Figure 1.5.2. Redundant AC Power and Load Sharing DC Power Supplies

Figure 1.5.3 adds redundant power supply buses in addition to giving redundant AC power, load sharing DC power supplies, and redundant power buses. Redundant AC power is fed to each AC input panel. Load sharing DC power supplies provide power to bus A and bus B. The system device is connected to redundant buses A and B.

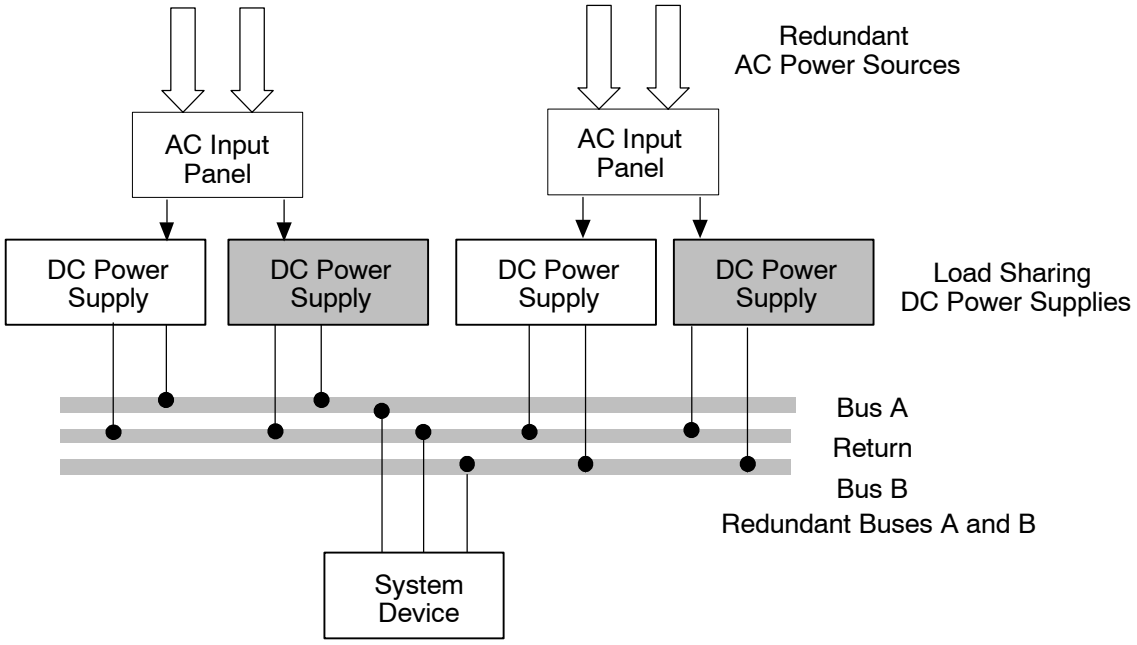


Figure 1.5.3. Redundant AC Power, Load Sharing DC Power Supplies, and Redundant Power Buses

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Section 1:
Electrical PeerWay

This section describes hardware and shows functional diagrams for the electrical PeerWay. The electrical PeerWay includes twinax PeerWay cables and PeerWay taps.

The PeerWay is fully redundant. Each PeerWay carries half the traffic and either one can carry the full load if the other fails. Two sets of twinax PeerWay cables and PeerWay Tap Boxes provide independent communication paths between the nodes. Figure 2.1.1 shows a PeerWay with two Tap Boxes and five nodes. Each node is attached to PeerWay A and PeerWay B through the Tap Box.

If there are four or fewer nodes, twinax PeerWay cables are not required. All connections can be made at a single PeerWay Tap, as shown on the right hand side of Figure 2.1.1.

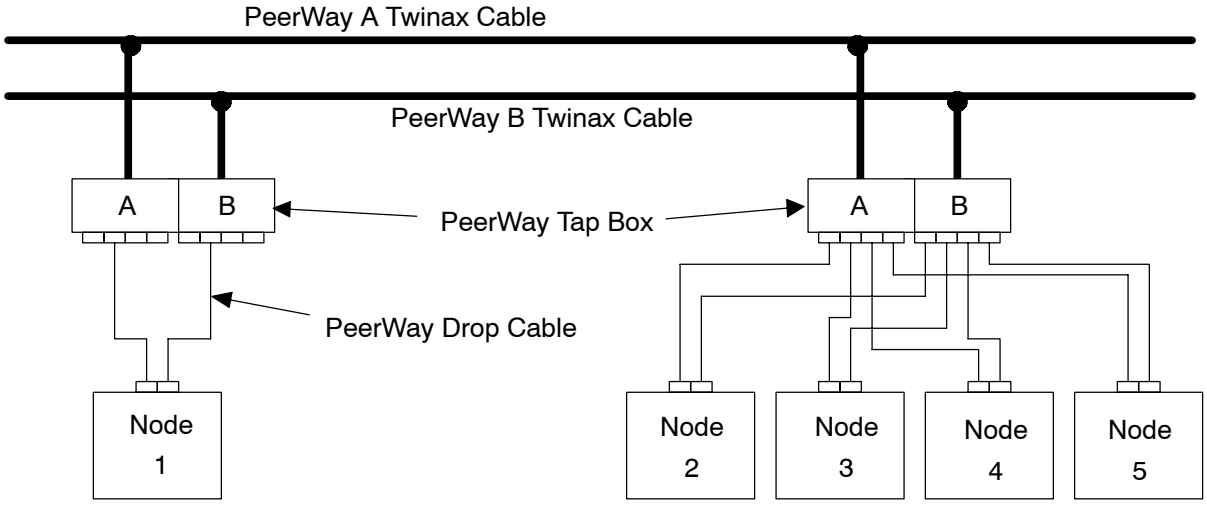


Figure 2.1.1. PeerWay Tap Box Connection

Figure 2.1.2 shows one side (A or B) of a typical electrical PeerWay. Up to 32 nodes may be attached to a PeerWay. Highway Interface Adaptors (HIA) may be used to connect multiple PeerWays.

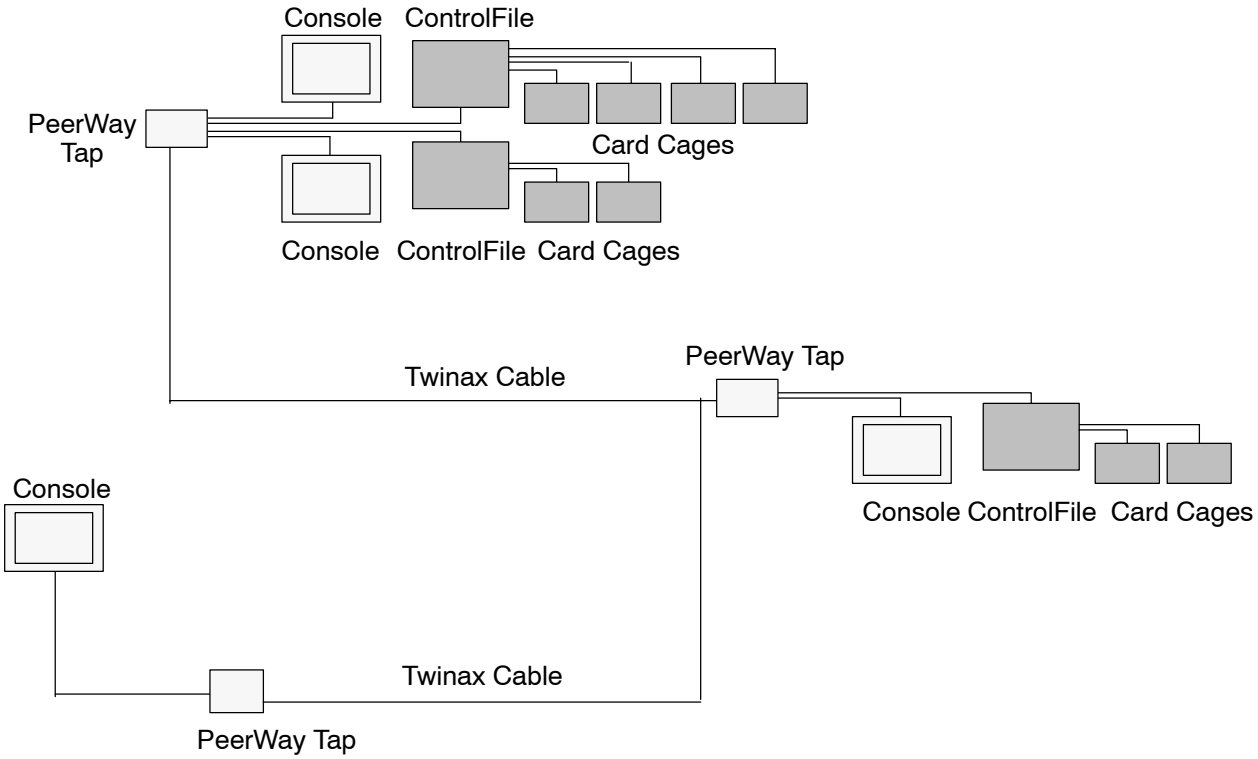


Figure 2.1.2. Electrical PeerWay (A or B Side Only)

Twinax PeerWay Tap Boxes

The PeerWay Tap Box is the connection between the electrical PeerWay and drop cables to ControlFiles, consoles, or other devices.

These tap boxes are availible:

- PeerWay A Tap Box
  - 10P52760001 CE Approved
  - 1984-0488-0001
- PeerWay B Tap Box
  - 10P52790001 CE Approved
  - 1984-0489-0001
- Mounting Plate 1984-0484-0002

One A and one B Tap Box are normally mounted on the mounting plate to make an assembly. They are marked “DATAWAY TAP A” and “DATAWAY TAP B” on the printed wiring assembly (PWA).

Table 2.1.1. PeerWay Tap Box Parts Replacement

Part	Part No.	Replaces	Comment
Tap A	10P52760001	1984-0488-0001	All installations.
	1984-0488-0001	10P52760001	Only in non-CE installations.
Tap B	10P52790001	1984-0489-0001	All installations.
	1984-0489-0001	10P52790001	Only in non-CE installations.

Figure 2.1.3 shows a functional diagram of a PeerWay Tap Box.

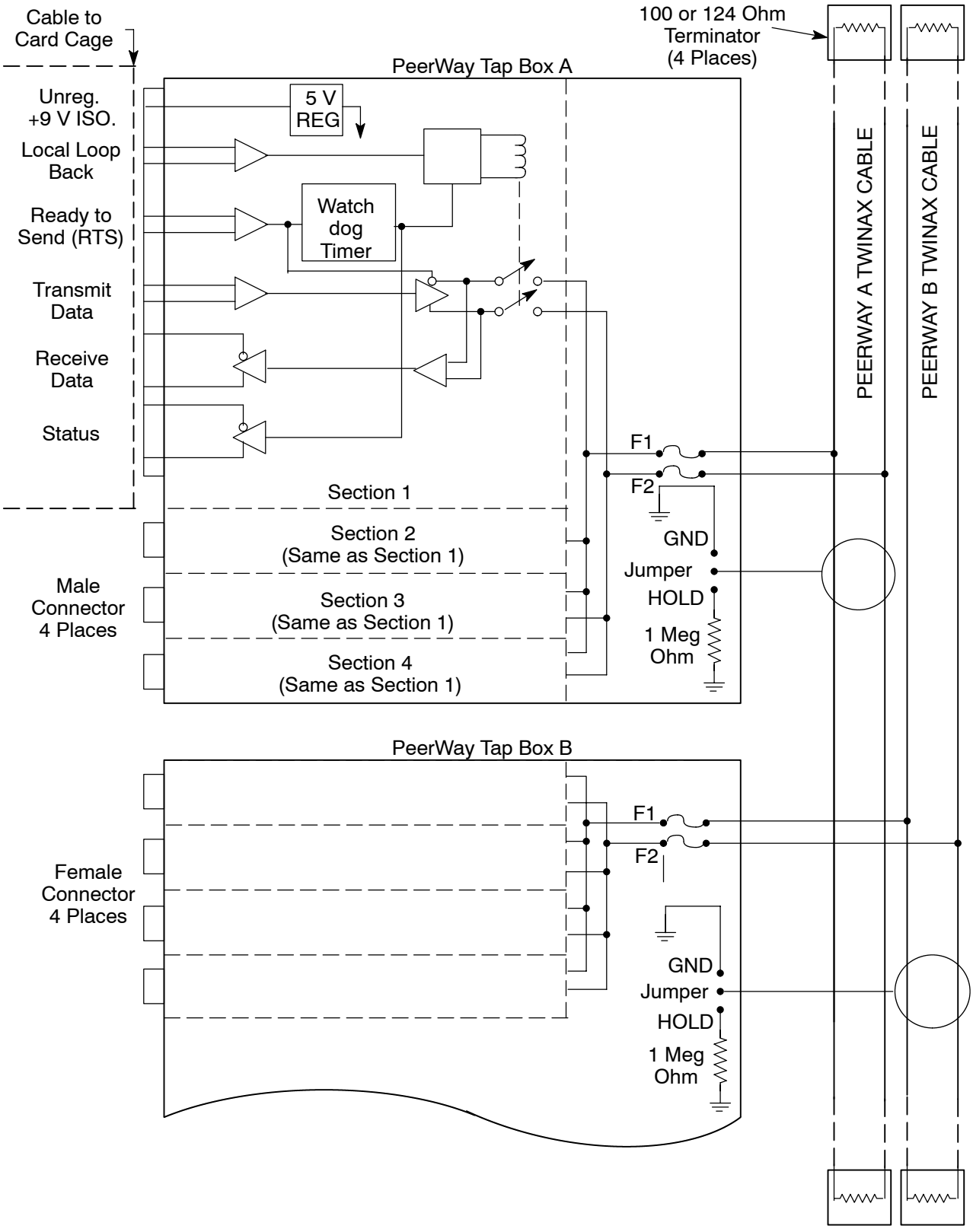


Figure 2.1.3. PeerWay Tap Functional Diagram

Each PeerWay Tap Box has four identical circuits that connect to four different nodes (system devices). The four circuits are isolated from each other so that if one node fails, other nodes will not be affected. There are four connections from the tap boxes to system device drop cables. The A tap box uses male connectors; the B tap box uses female connectors.

Each tap box has two fuses, F1 and F2. The fuses are in line with the PeerWay so a problem with either box is indicated by a communication failure on one line but not on the other.

The PeerWay Tap is considered to be one drop on the PeerWay.

Connections are made between two A tap boxes and two B tap boxes with twinax cable and a “T” connector. Buffers transmit and receive data to the different nodes. For power, an onboard 5 volt regulator is provided for each of the four nodes, with the unregulated 9 volts brought to each tap circuit from the originating node. Thus, each tap receives power from the node to which it is cabled.

The PeerWay Tap connects to a PeerWay Buffer Card (in a ControlFile) or a PeerWay Interface Card (in a console) through a PeerWay Drop Cable. The Loopback circuit on the PeerWay Tap drives the local loopback relay. When the loopback relay is de-energized, data is not transmitted to the PeerWay. A transmit circuit on the tap takes the data transmitted from the node and changes it to transistor to transistor logic (TTL) and then to RS-422 for transmission on the PeerWay. The Ready To Send (RTS) circuit drives the RTS signal to enable the transmitter output. This circuit has a watchdog timer on its output to disable the loopback relay. This prevents a problem on the node from tying up the PeerWay. A feedback transmitter is used to tell the node that a time-out is in progress. The Receive circuit in the tap buffers data from the PeerWay to the node. Communications with the node are in RS-422 format.

In a system with four nodes or less and in which a twinax is not needed for long communication distance, all connections can be made through the PeerWay Tap with 100 ohm terminators installed on all of the twinax connectors.

PeerWay Tap Test Points

To access the PeerWay Tap test points, loosen the four captive screws on the tap and turn the tap cover so that the board is visible. There are four sets of brown and yellow test points on each board. Each point is a 5 volt DC (4.75 – 5.25) voltage regulator with power drawn from the node to which it is connected. Figure 2.1.4 shows the test point locations.

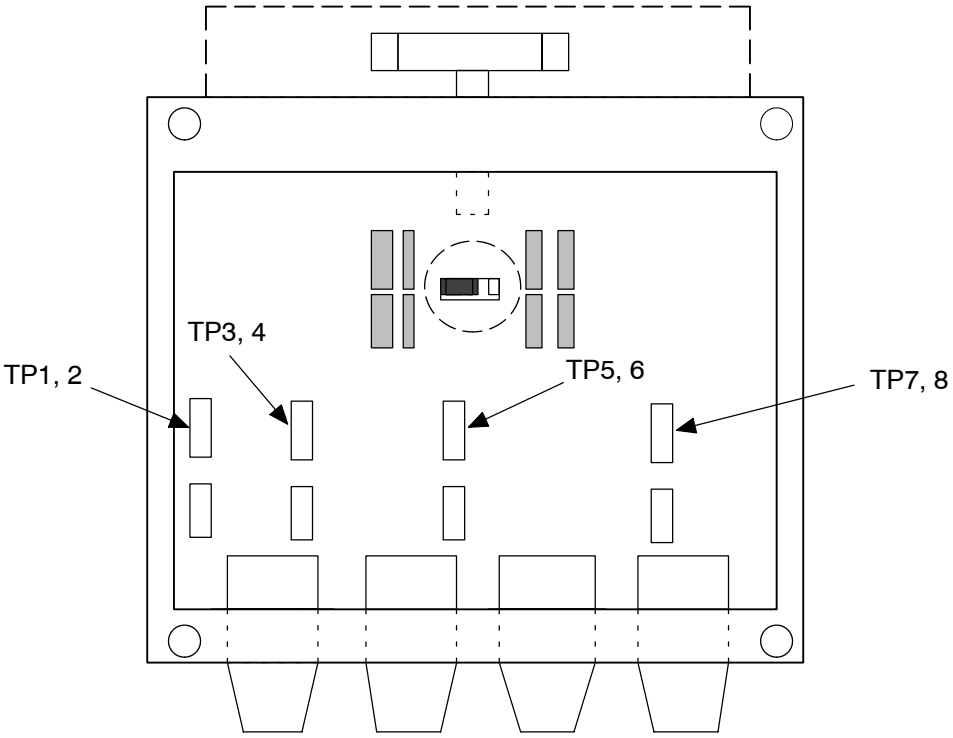


Figure 2.1.4. PeerWay Tap Test Points

PeerWay Tap Fuses

The PeerWay Tap has two special fuses (F1, F2) soldered into the board. These fuses are not field replaceable.

Grounding an Electrical PeerWay

Each tap box assembly must be grounded by having the metal case connected to ground. The twinax PeerWay shield must be connected to ground at only one tap box set. The shield is grounded by having the screw at the “GROUND” position or the jumper at “GND” on the A and B boxes of the set. The tap nearest to the system ground point should be used to ground the PeerWay shield.

❑ **To ground the Twinax PeerWay Shield on Tap Boxes 10P52760001 and 10P52790001:**

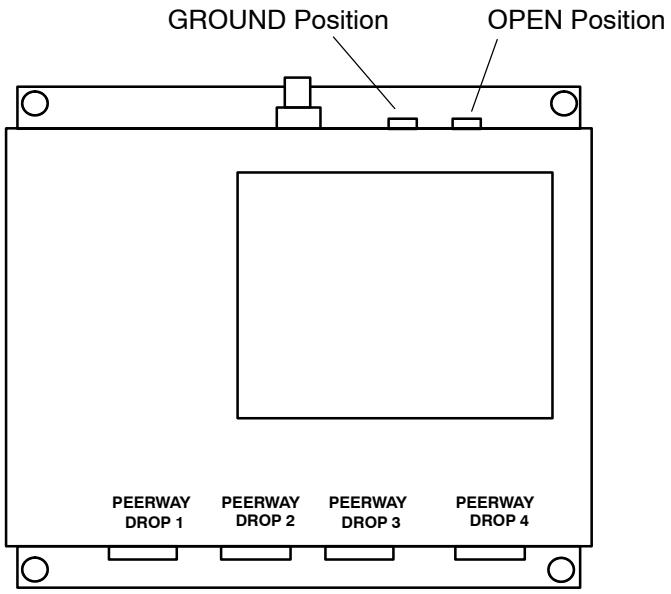


Figure 2.1.5. Tap Boxes 10P52760001 and 10P52790001

1. Move the grounding screw from the “OPEN” to the “GROUND” position on tap boxes A and B.
2. To prevent a multiple ground of the Twinax PeerWay shield, check all other taps on the PeerWay to make sure that the grounding screws or jumpers are in the OPEN or HOLD position.
3. Check that no connector body can touch grounded metal. Grounding a connector body can lead to ground loops that are very hard to locate.

❑ **To ground the Twinax PeerWay Shield on Tap Boxes 1984-0488 and 1984-0489:**

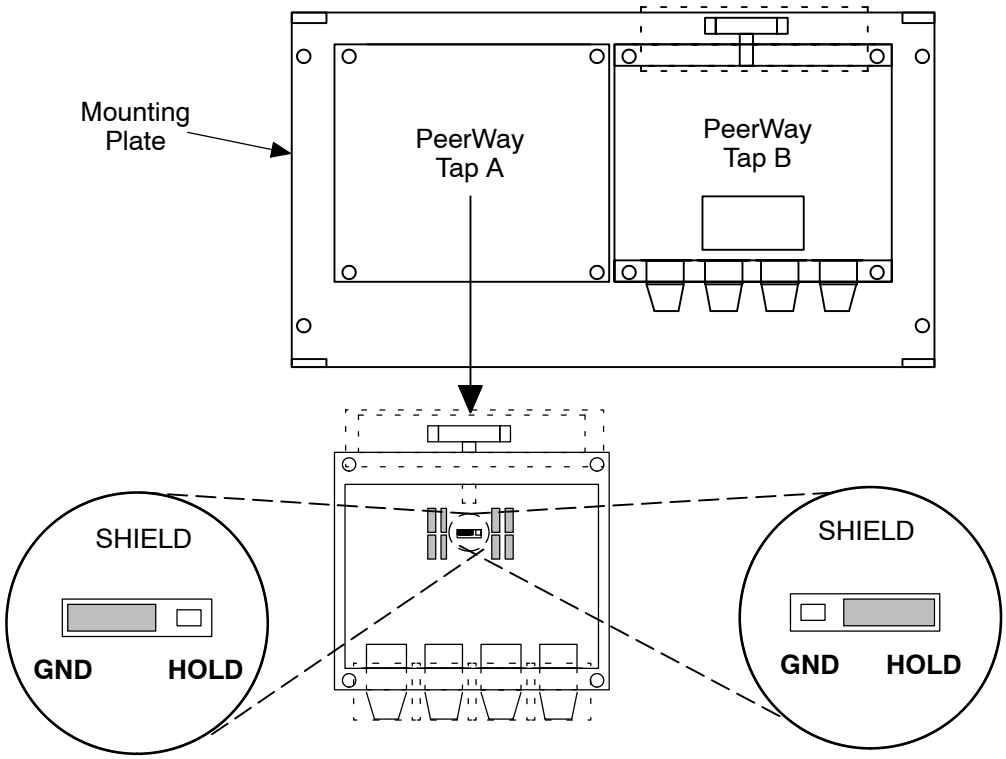


Figure 2.1.6. PeerWay Tap Ground Jumper

1. Remove the PeerWay Tap by loosening the four captive screws that secure it to the mounting plate. Refer to Figure 2.1.6.
2. Turn the Tap over to expose the circuit board.
3. Place the jumper in the GND (ground) position.
4. Reinstall the Tap on the mounting plate.
5. Repeat the procedure for the adjoining PeerWay tap B.
6. To prevent a multiple ground of the Twinax PeerWay shield, check all other taps on the PeerWay to make sure that the grounding screws or jumpers are in the OPEN or HOLD position.
7. Check that no connector body can touch grounded metal. Grounding a connector body can lead to ground loops that are very hard to locate.

Twinax PeerWay Cable

Twinax PeerWay cable provides the communication connection between electrical PeerWay nodes. The twinax PeerWay transmits messages serially at a rate of one million bits per second. As many as 32 system devices such as ControlFiles and consoles can be connected to the twinax PeerWay.

The twinax PeerWay cable consists of a twisted pair of wires within an overall shield. The electrical specification is RS-422, a form of high speed data communication using two lines driven differentially between 5 volts and ground. The twinax shield is used to shield the data lines from outside electrical interference.

Twinax PeerWay cables are used in pairs, called A and B. In order to identify the cables, the A cable should be color coded green and the B cable should be color coded blue. The cable connectors can be marked with a felt-tip marker. Corresponding A and B PeerWay tap boxes are marked with green and blue labels.

T-style connectors are used to connect the twinax cable to the bulkhead connector on the PeerWay tap. Figure 2.1.7 shows the cable connections to a Tap Box.

CAUTION

The connector must have an insulating sleeve to prevent accidental grounding of the Twinax PeerWay shield.

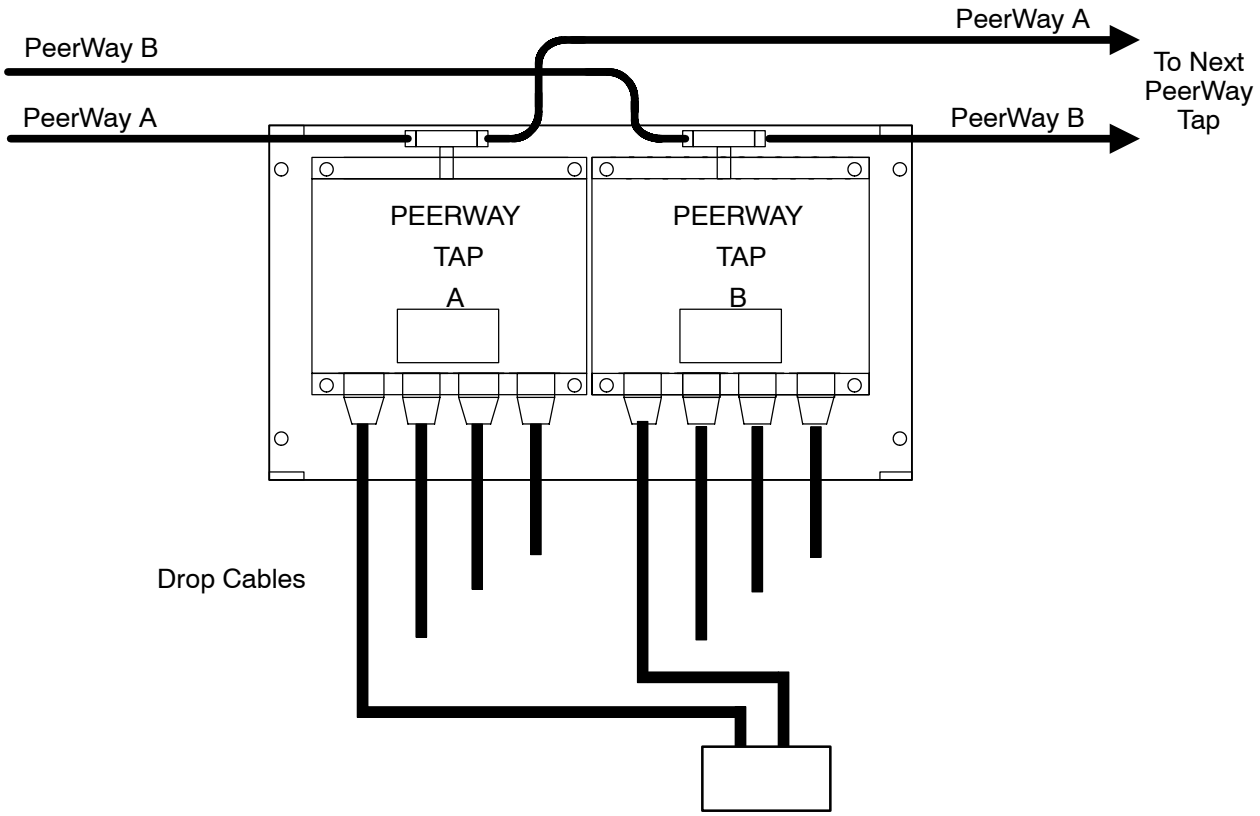


Figure 2.1.7. PeerWay Tap Box Connection

Twinax PeerWay Cable Termination

Both ends of each standard (100 ohm) twinax PeerWay cable are equipped with a 100 ohm impedance terminator (1984–1065–0001). Extended length (124 ohm) cable is equipped with a 124 ohm impedance terminator (1984–1065–0002). The terminator eliminates noise and reflections on the cable. Figure 2.1.8 shows terminator connections.

In a system with four nodes or less and in which a twinax cable is not needed, all connections can be made through a single PeerWay Tap with four 100 ohm terminators installed on the twinax connectors.

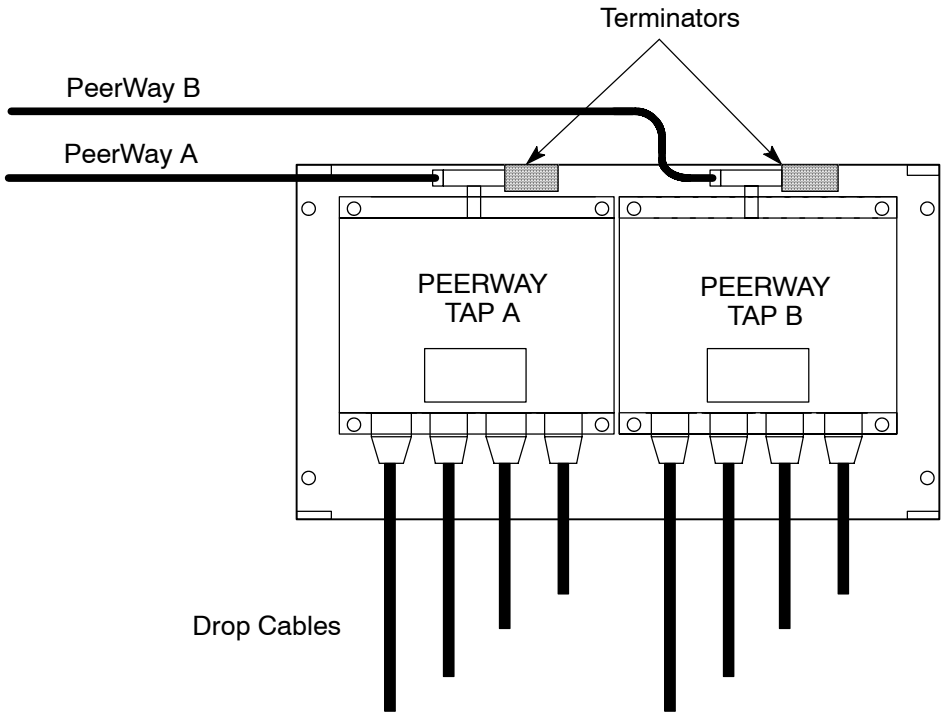


Figure 2.1.8. Electrical PeerWay Termination

Installing Twinaxial Connectors

Two types of connectors are available:

- Crimp Type (100 ohm cable only) 1167-0016-0001
- Solder Type (100 ohm cable) G12885-0001
  (124 ohm Beldin cable) G12885-0006
  (124 ohm Intercomm cable) G12885-0008

NOTE: An insulating sleeve should be placed over the metal barrel of the connector to prevent inadvertent grounding of the twinax shield.

❑ **To install a crimp-type twinaxial connector:**

1. Strip the cable as shown in Figure 2.1.9.
2. Refer to the crimping instructions (AS047401) shipped with the connector for installation instructions.
3. Put an insulating sleeve over the connector.

NOTE: A Connector Crimp Tool (1167-0016-0002) is required. A Crimp Tool Kit (1167-0016-0007) is available. The kit has 20 connectors and a crimp tool.

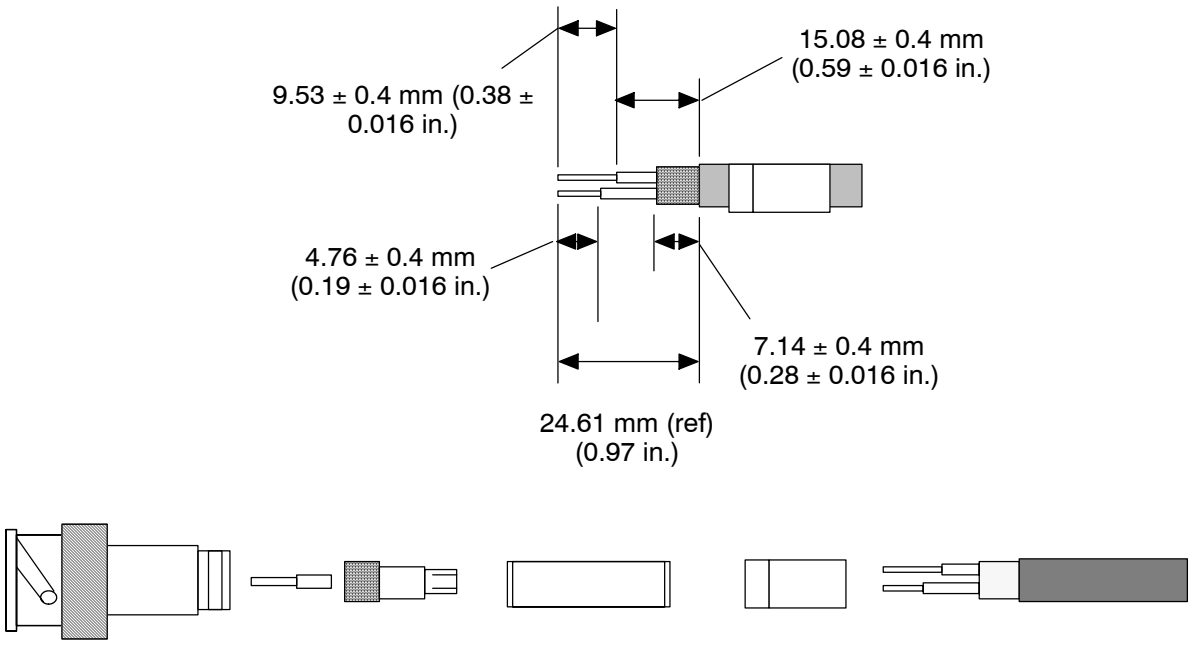


Figure 2.1.9. Crimp-type Twinaxial Connector

❑ **To install a solder-type twinaxial connector:**

1. Place the wrench crimp nut on the cable. Refer to step A of Figure 2.1.10.
2. Strip the cable as shown and bend the braid outward to allow free entry of cone.
3. Push the cone under the braid until bottomed (step B).
4. Bend the long conductor outward and install the shield over the copper conductor.
5. Position the pin and solder in place.
6. Wrap the conductor between the shield ridges and solder (step C). Do not allow the solder to extend above ridges.
7. Bring the wrench crimp nut onto the tapered portion of the cone (step D).
8. Assemble the connector body over the cable assembly and engage with the wrench crimp nut. Hold the cable and the connector body stationary while tightening the nut.
9. Wrench tighten the nut to 4.5–5.5 N•m (40–50 in-lb) torque.
10. Put an insulating sleeve over the connector.

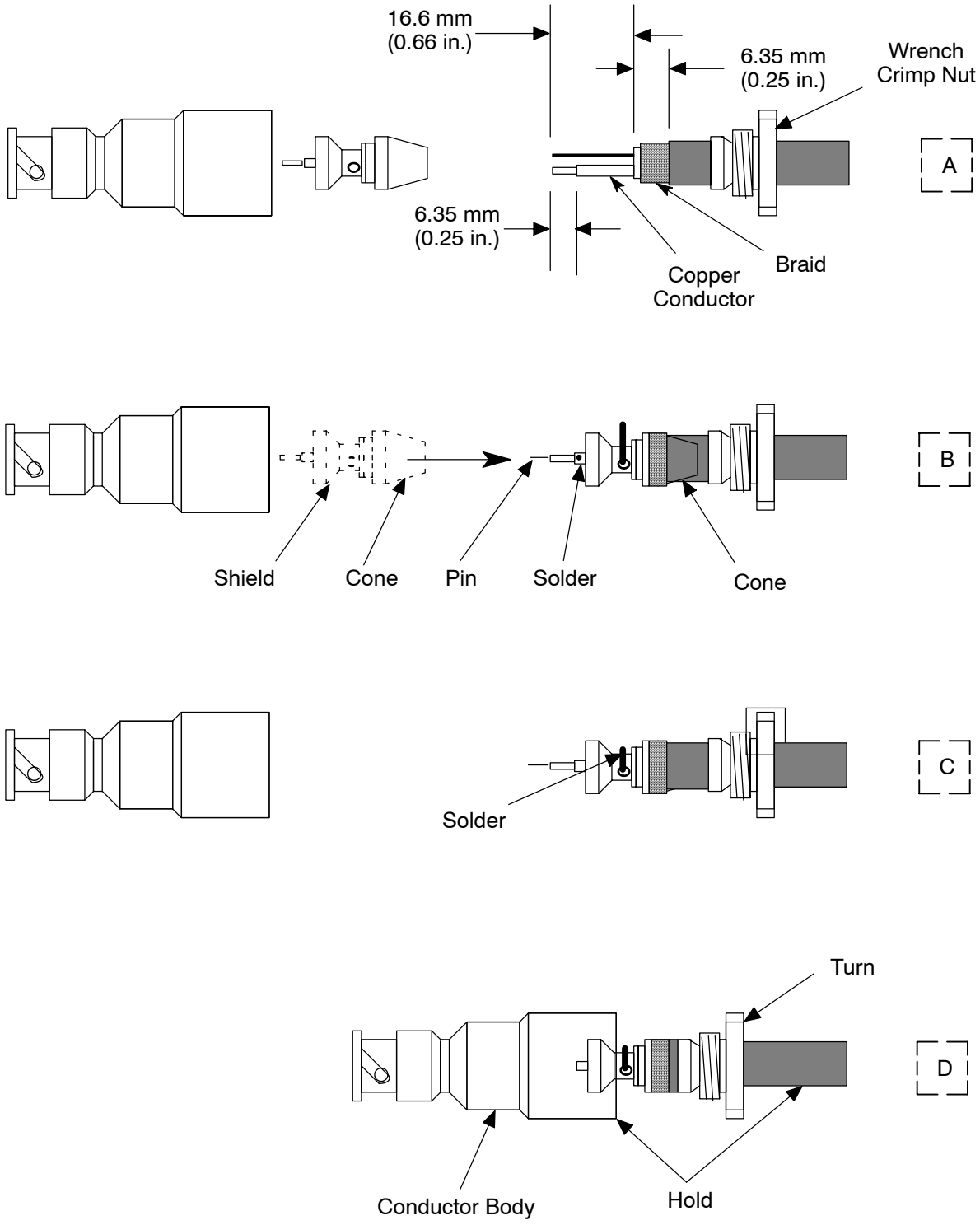


Figure 2.1.10. Solder-type Twinaxial Connector

Section 2:
Optical PeerWay

This section gives hardware descriptions and functional diagrams for the optical PeerWay. The optical PeerWay uses fiber optic cable and provides complete electrical isolation between system components.

An optical PeerWay uses a passive star architecture with a star coupler feeding up to eight optical fiber runs. Each optical fiber run terminates at an optical tap box. The optical fiber run may include repeaters and/or attenuators to adjust signal strength. Figure 2.2.1 shows an overview of an optical PeerWay.

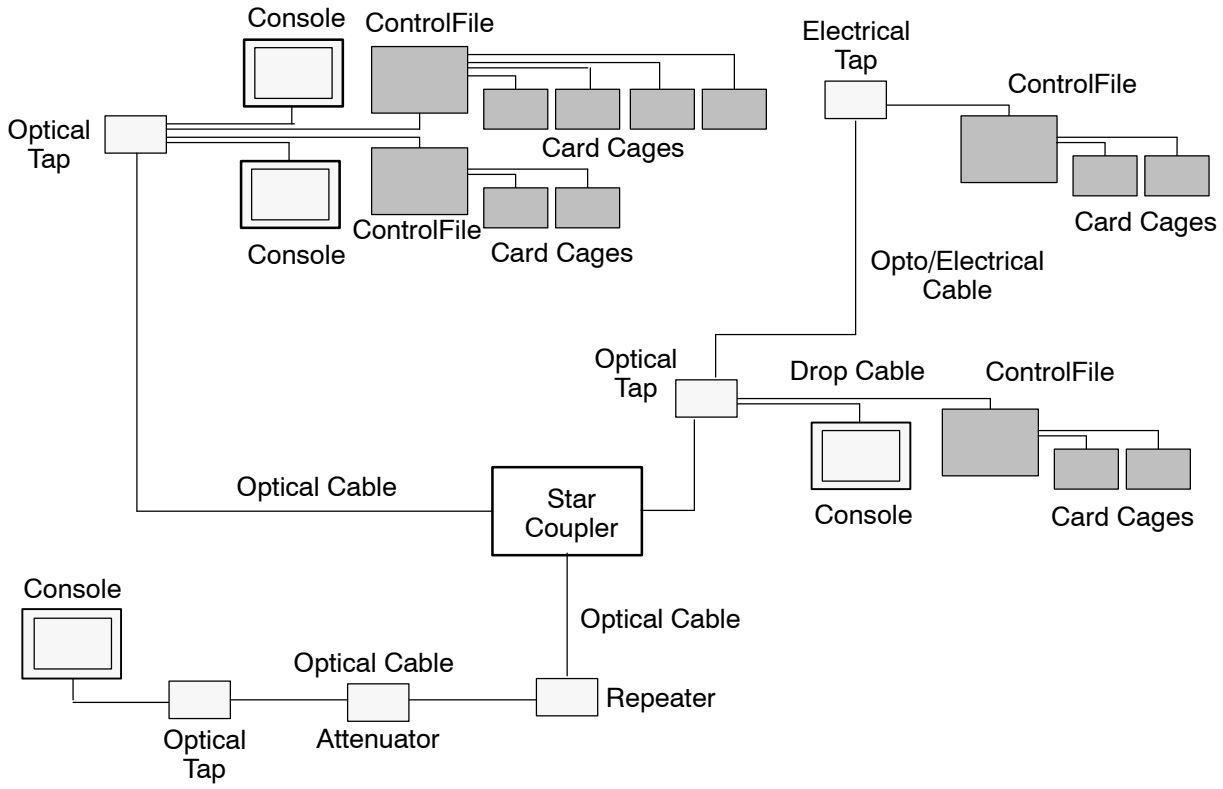


Figure 2.2.1. Optical PeerWay (A or B)

An optical tap box can support up to four directly connected devices. Additional devices may be connected to the optical tap box by daisy chaining up to three electrical tap boxes using special opto/electrical cables. Each electrical tap box may support up to four devices. Figure 2.2.2 shows one side (A or B) of an optical PeerWay.

Each side (A and B) of the optical PeerWay uses a dual fiber optic cable, one fiber for transmission and one for reception. The fiber optic cable carries messages serially at a rate of one million bits per second. A maximum of 32 system devices can be connected to an optical PeerWay. A Highway Interface Adaptor (HIA) can be used to connect two optical PeerWays or an optical and an electrical PeerWay.

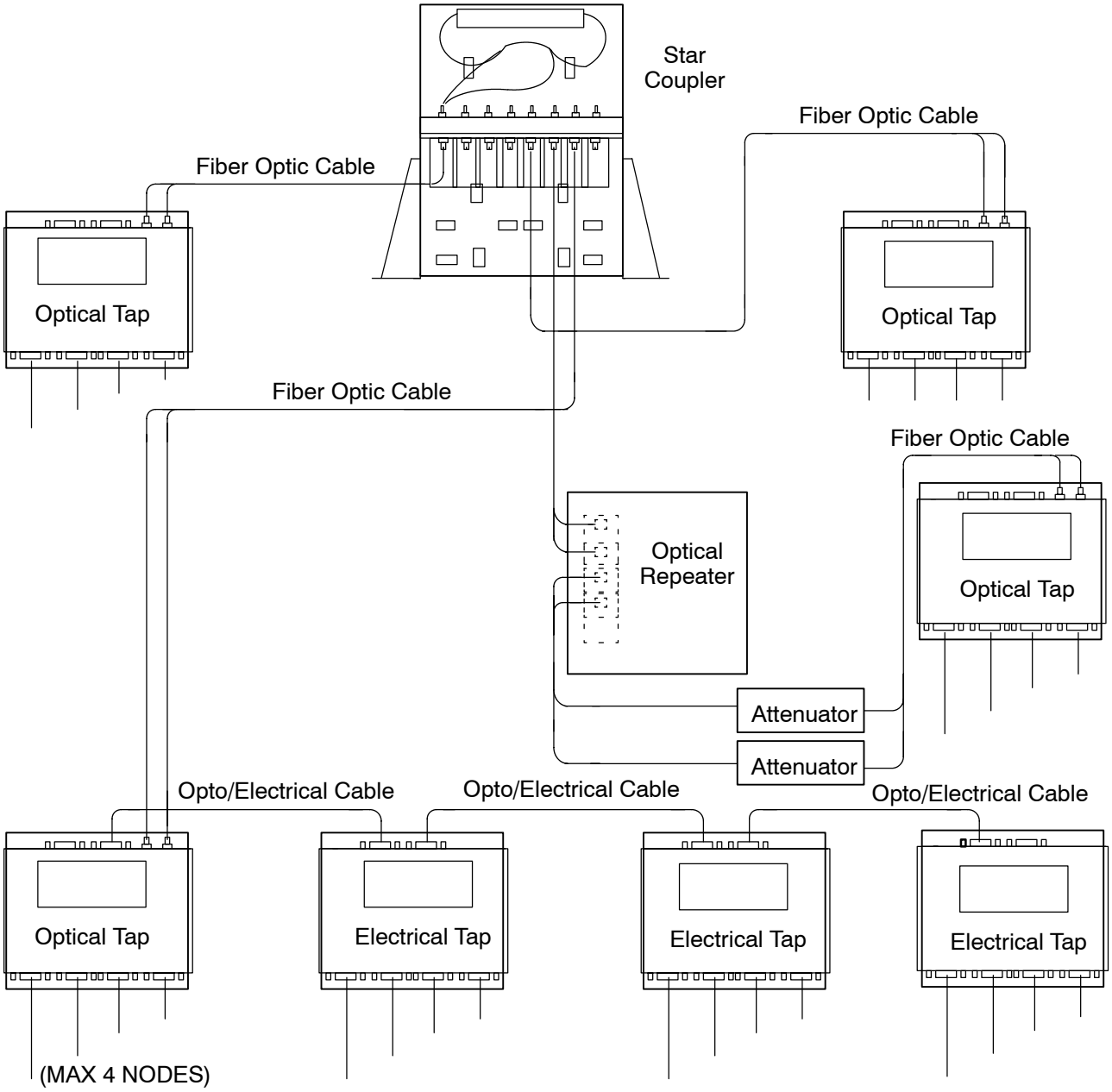


Figure 2.2.2. Optical PeerWay Components

Optical Tap Box

The tap consists of a mounting plate and two Optical Tap Boxes:

- PeerWay A (1984-3211-0001 or 1984-1191-0001)
- PeerWay B (1984-3214-0001 or 1984-1192-0001)

The Optical PeerWay Tap should always be used with a Fiber Optic Cable Tie Panel Assembly (1984-2231-0001) to securely dress and tie down fiber optic cables. The cable tie assembly mounts at the top of the Optical PeerWay Tap. Figure 2.2.3 shows the Optical PeerWay Tap and the Fiber Optic Cable Tie Panel Assembly.

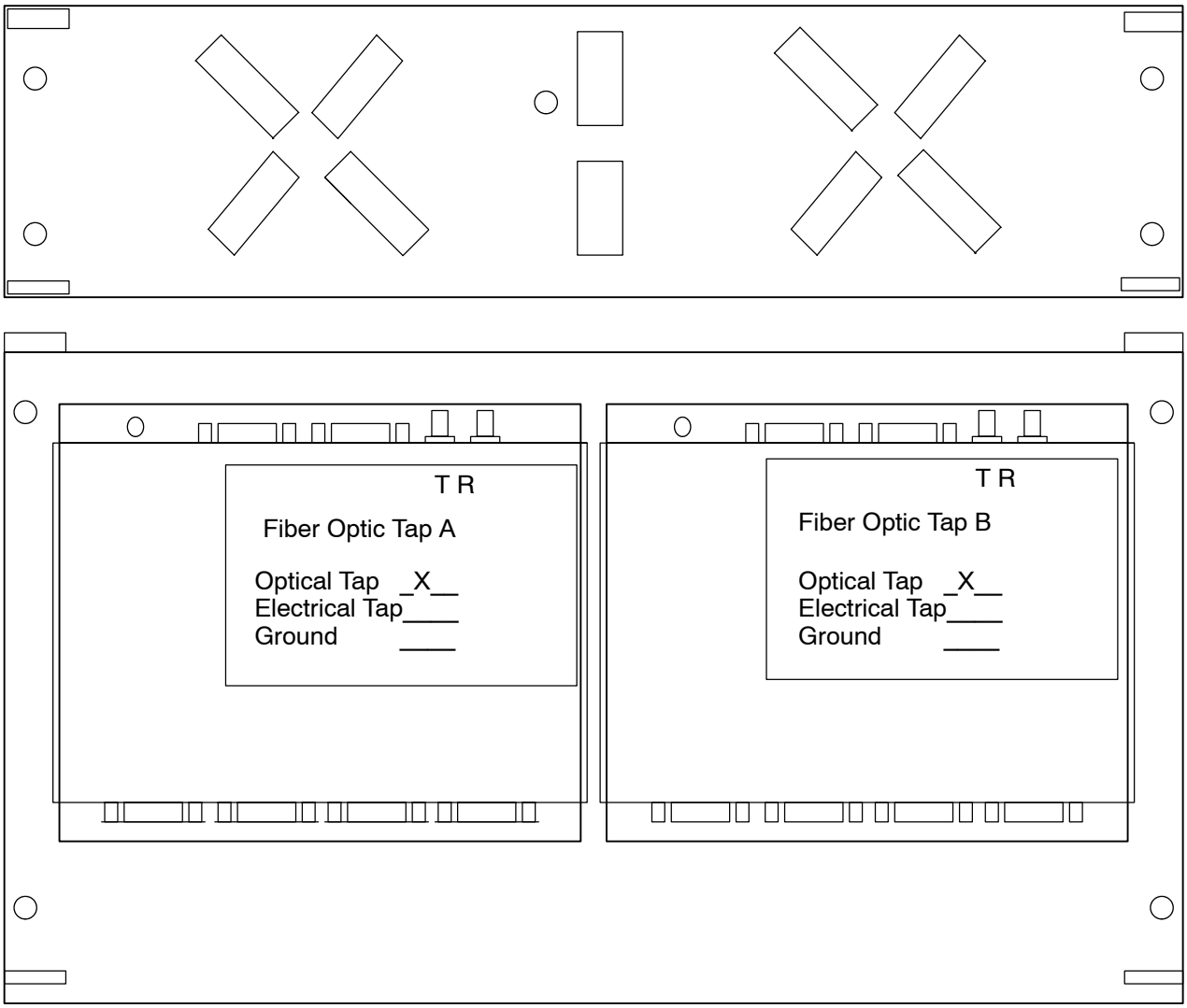


Figure 2.2.3. Optical PeerWay Tap and Cable Tie Panel Assembly

Up to three Electrical Tap Boxes may be daisy chained to an Optical Tap Box using special Opto/Electrical cables.

Figure 2.2.4 shows the functional diagram of an Optical Tap Box.

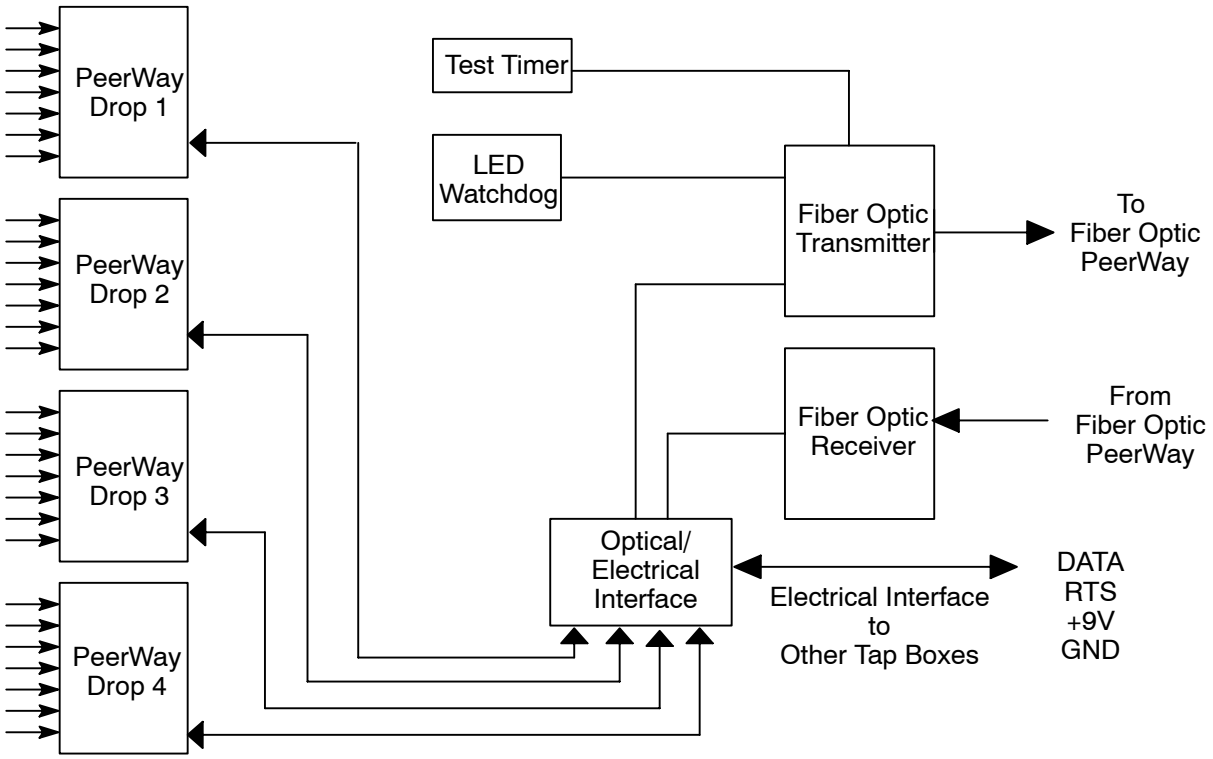


Figure 2.2.4. Optical Tap Block Diagram

The -3211 and -1191 parts are fully interchangeable. Similarly, the -3214 and -1192 parts are fully interchangeable as shown in Table 2.2.1.

Table 2.2.1. Optical Tap Box Replacement Data

Part No.	Replaces	Comment
1984-3211-0001	1984-1191-0001	PeerWay A Optical Tap Box
1984-1191-0001	1984-3211-0001	PeerWay A Optical Tap Box
1984-3214-0001	1984-1192-0001	PeerWay B Optical Tap Box
1984-1192-0001	1984-3214-0001	PeerWay B Optical Tap Box

Connecting Cables to an Optical Tap Box

Figure 2.2.4 shows the fiber optic, opto/electric cable, and PeerWay drop cable connections to an optical tap box.

- Optical Tap Box “A” to Electrical Tap Box “A”, use Opto/Electric Cable (1984–1195–xxxx).
- Optical Tap Box “B” to Electrical Tap Box “B”, use Opto/Electric Cable (1984–1196–xxxx).

The Optical Tap Box can be in the middle of the daisy chain if desired. Both electrical connectors may be used at the same time.

Devices connect to the optical tap box with normal PeerWay drop cables.

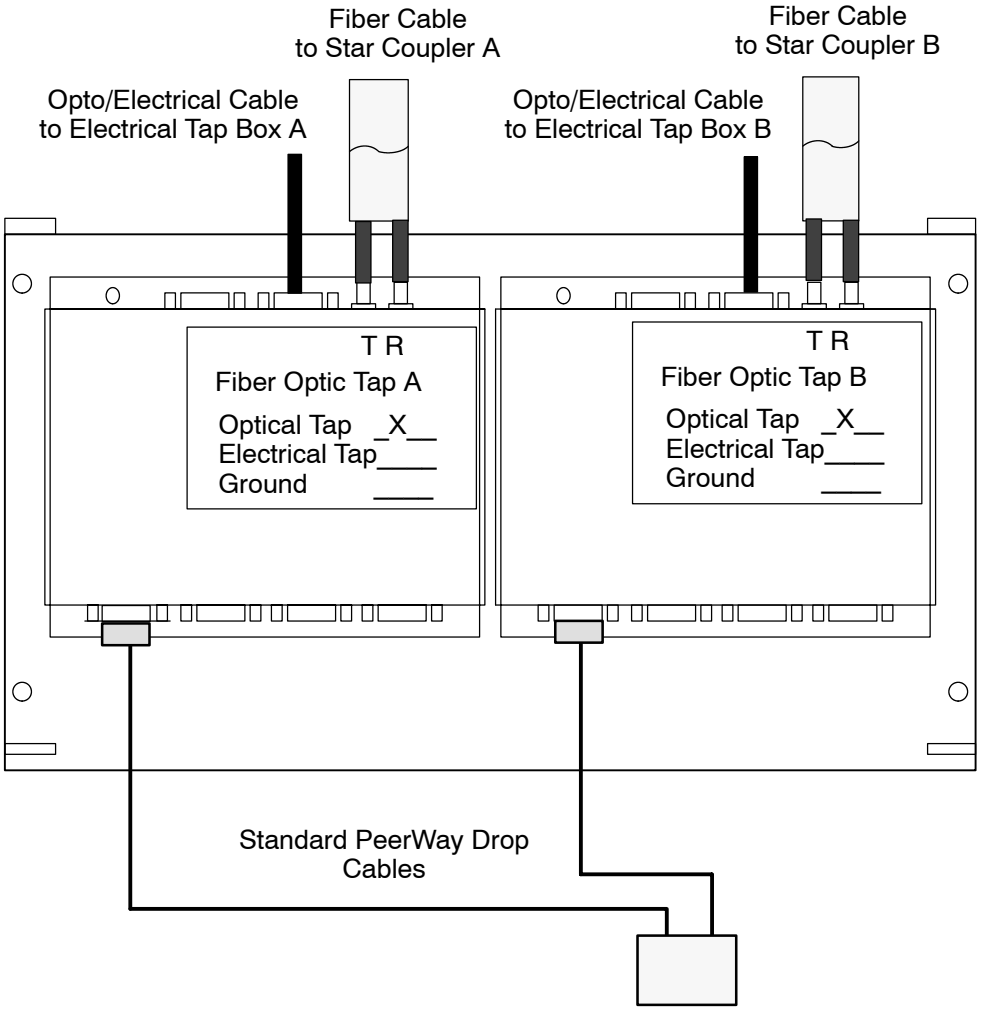


Figure 2.2.5. Cable Connection to Optical Tap Box

Electrical Tap Box

The tap consists of a mounting plate and two Electrical Tap Boxes:

- PeerWay A (1984-3211-0002 or 1984-1193-0002)
- PeerWay B (1984-3214-0002 or 1984-1194-0002)

Figure 2.2.6 shows the PeerWay Electrical Tap set. Figure 2.2.7 shows the functional diagram of an Electrical Tap Box.

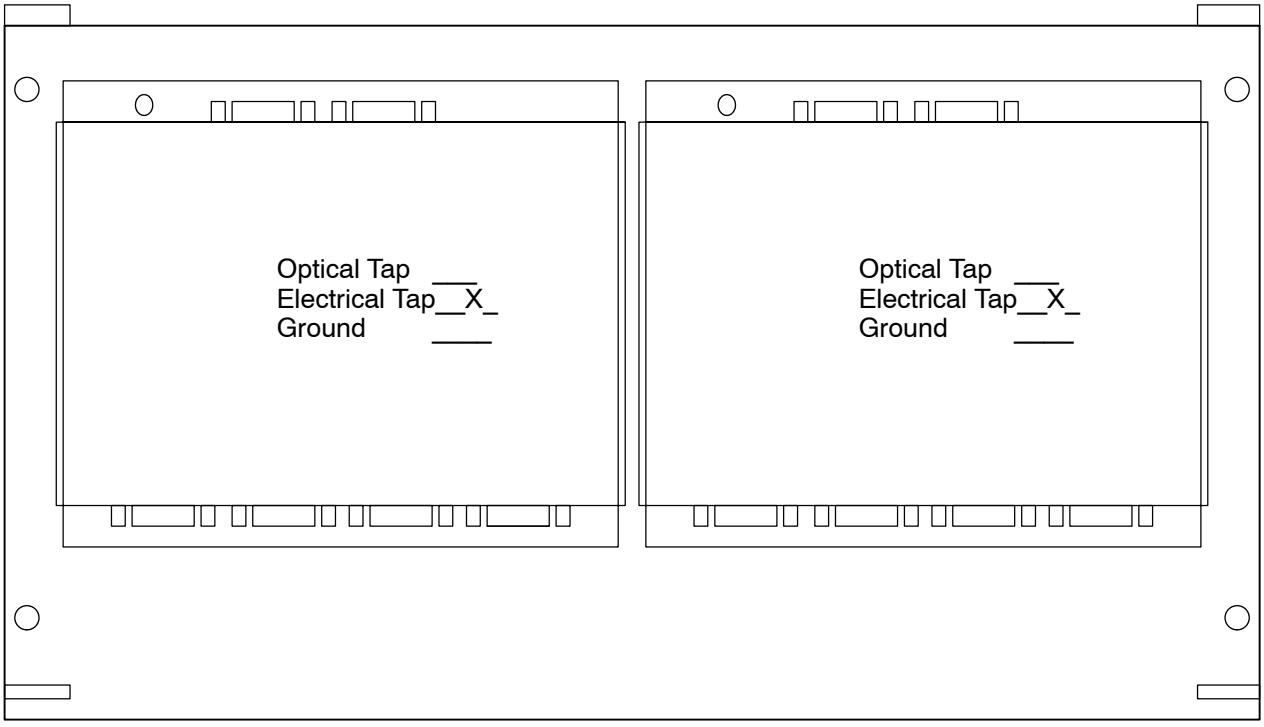


Figure 2.2.6. Electrical Tap Box Set

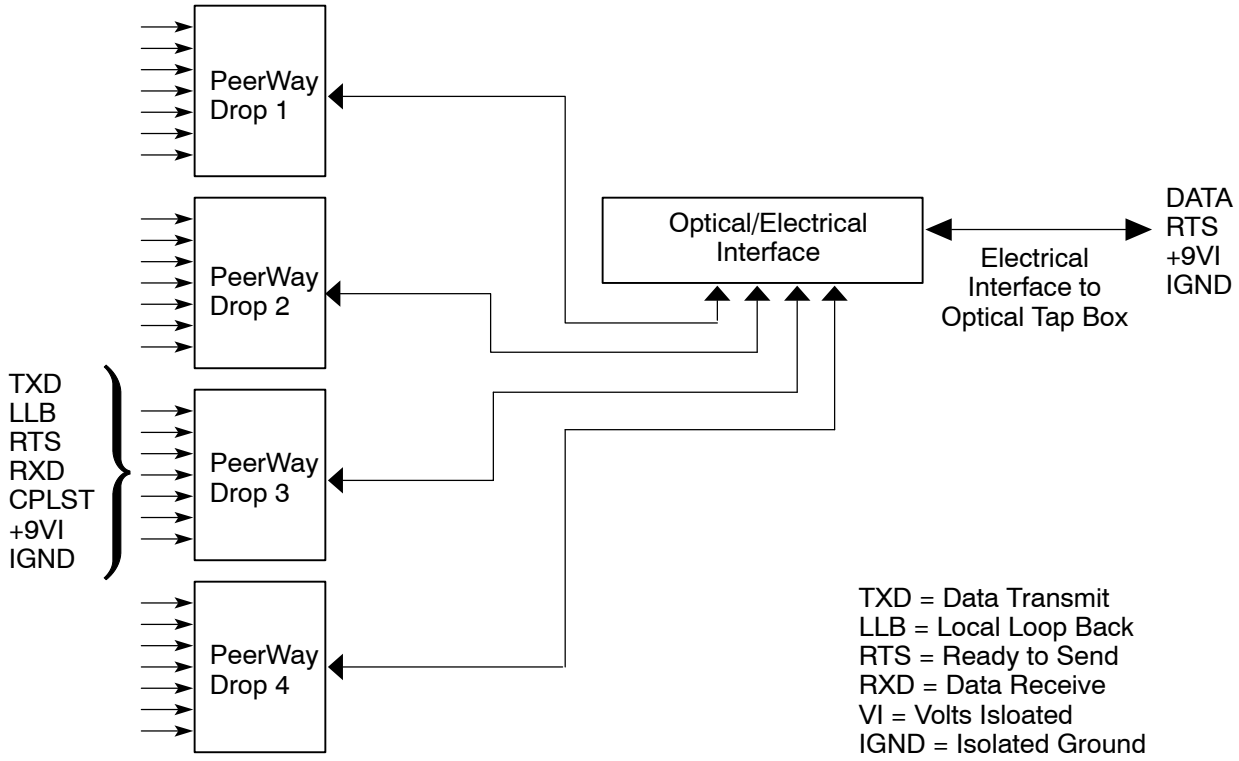


Figure 2.2.7. Electrical Tap Block Diagram

Up to 3 Electrical Tap Boxes may be daisy chained to an Optical Tap Box using special Opto/Electrical cables. The maximum allowable length of the chain is 30 meters (100 feet). Devices are connected to the electrical tap box with normal PeerWay drop cables.

Use Opto/Electric Cable (1984-1195-9999) to connect Electrical Tap Boxes “A”.

Use Opto/Electric Cable (1984-1196-9999) to connect Electrical Tap Boxes “B”.

The -3211 and -1193 parts are fully interchangeable. Similarly, the -3124 and -1194 parts are fully interchangeable as shown in Table 2.2.2

Table 2.2.2. Electrical Tap Box Replacement Data

Part No.	Replaces	Comment
1984-3211-0002	1984-1193-0001	PeerWay A Electrical Tap Box
1984-1193-0001	1984-3211-0002	PeerWay A Electrical Tap Box
1984-3214-0002	1984-1194-0001	PeerWay B Electrical Tap Box
1984-1194-0001	1984-3214-0002	PeerWay B Electrical Tap Box

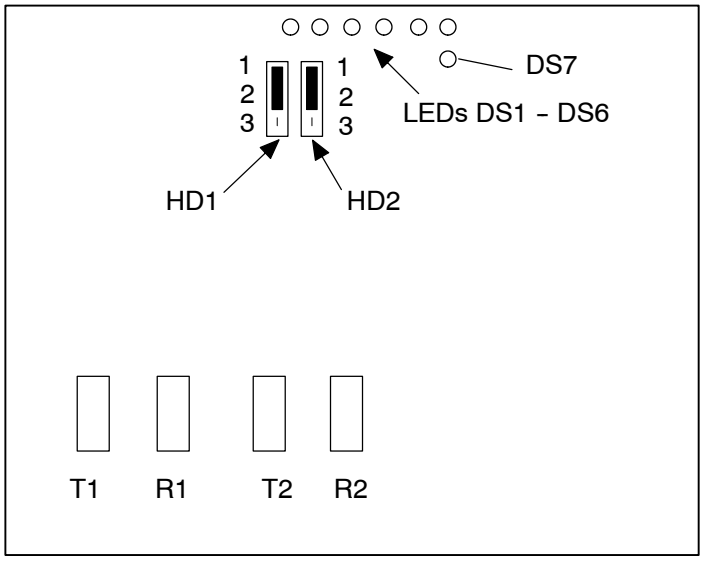
Optical Repeater/Attenuator

The Optical Repeater/Attenuator (1984-2350-0002) is used to adjust signal levels in an optical PeerWay.

It is marked “FIBER OPTIC REPEATER” on the PWA (1984-0514-000x).

Optical Repeater/Attenuator Jumpers and LEDs

Figure 2.2.8 shows the jumper and LED locations on the card within the Optical Repeater/Attenuator. Table 2.2.3 gives the jumper settings for normal and test operation.



LEDs

DS1	Hardware Good
DS2	Hardware Bad
DS3	+30V Fuse Blown
DS4	FO TX1 Failed*
DS5	FO TX2 Failed*
DS6	Data 1
DS7	Data 2

* FO = Fiber Optic

Figure 2.2.8. Optical Repeater/Attenuator LED and Jumper Locations

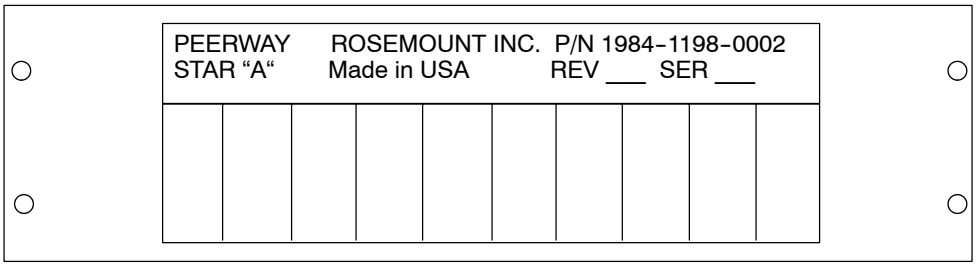
Table 2.2.3. Optical Repeater/Attenuator Jumper Settings

Jumper	Normal Position	Test Position
HD1	1-2	2-3
HD2	1-2	2-3

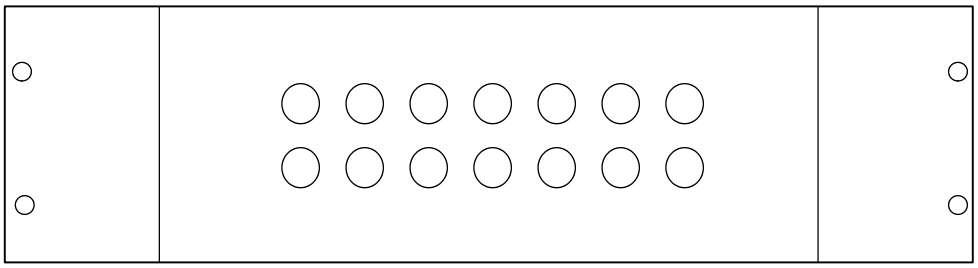
Star Coupler

The Star Coupler (1984–1198–000x) provides optical connection for up to eight fiber optic cable pairs (transmit and receive). The coupler is a passive device that connects the optical fibers to provide circuit continuity. Figure 2.2.9 shows the Star Coupler label and the eight fiber optic connectors.

There are no serviceable parts in a Star Coupler.



Front View (with cover in place)



Front View (with cover removed)

Figure 2.2.9. Star Coupler

Grounding an Optical PeerWay

Each fiber optic run from the star coupler must be grounded at one and only one tap box (optical or electrical). The tap should have low resistance to earth ground (preferably less than one ohm). Both tap box A and tap box B must be grounded. As an example, Figure 2.2.10 shows a fiber optic PeerWay. All of the shaded tap boxes are grounded.

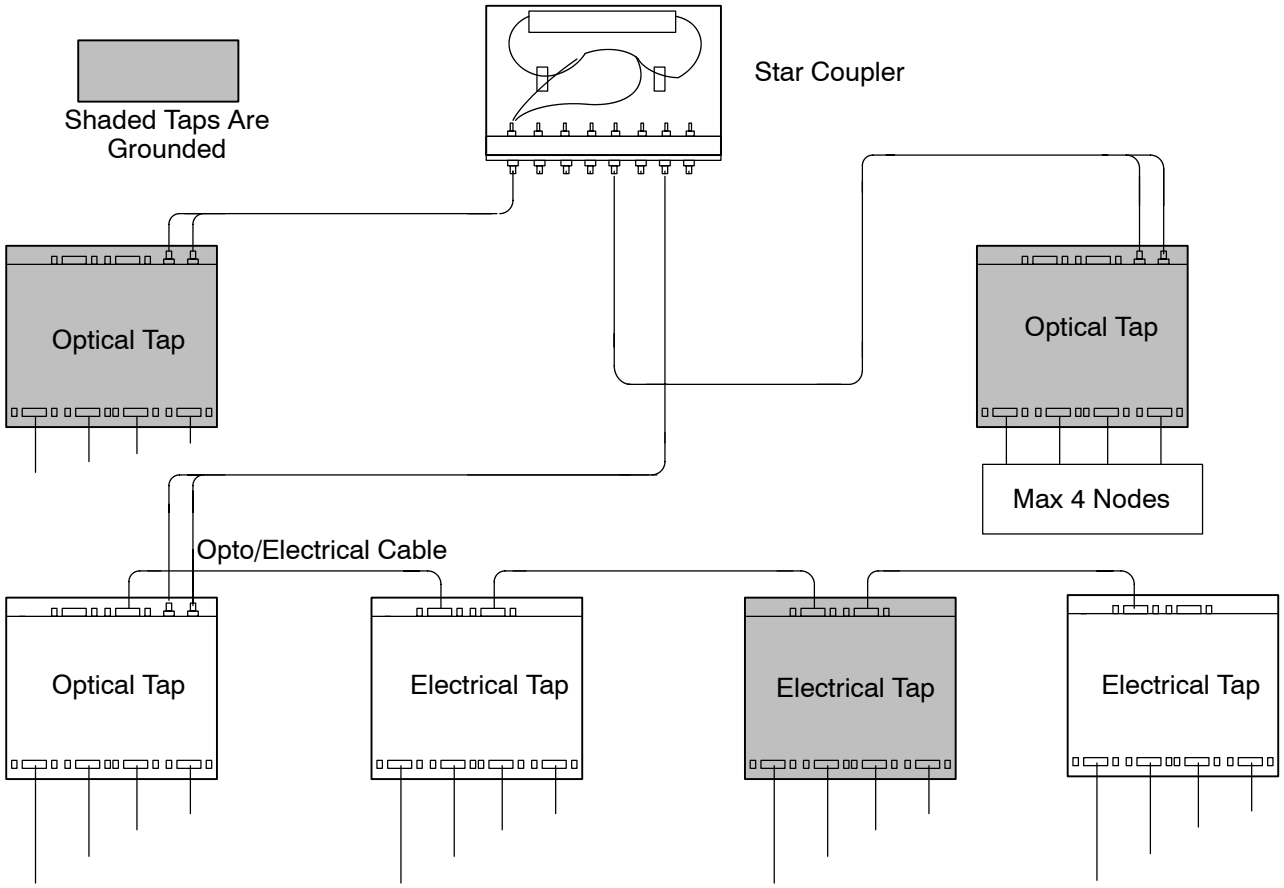


Figure 2.2.10. Optical PeerWay Grounding

❑ **To ground an optical or electrical tap box:**

1. Free the fiber optic tap A by loosening the four captive screws that secure it to the mounting plate. Refer to Figure 2.2.11.

NOTE: Perform this procedure before connecting the fiber optic cables to the tap boxes. However, if the fiber optic cables are attached to the tap, do not turn the tap over. Move the tap away from the mounting plate just enough to move or check the jumper position.

2. Turn the tap over to expose the circuit board.
3. Place the jumper in the GND (ground) position.
4. Reinstall the tap on the mounting plate.
5. Repeat the procedure for the other PeerWay tap at this location.
6. To prevent multiple grounds, remove and check all other taps on the fiber optic connection to make sure that the jumpers are in the HOLD position.

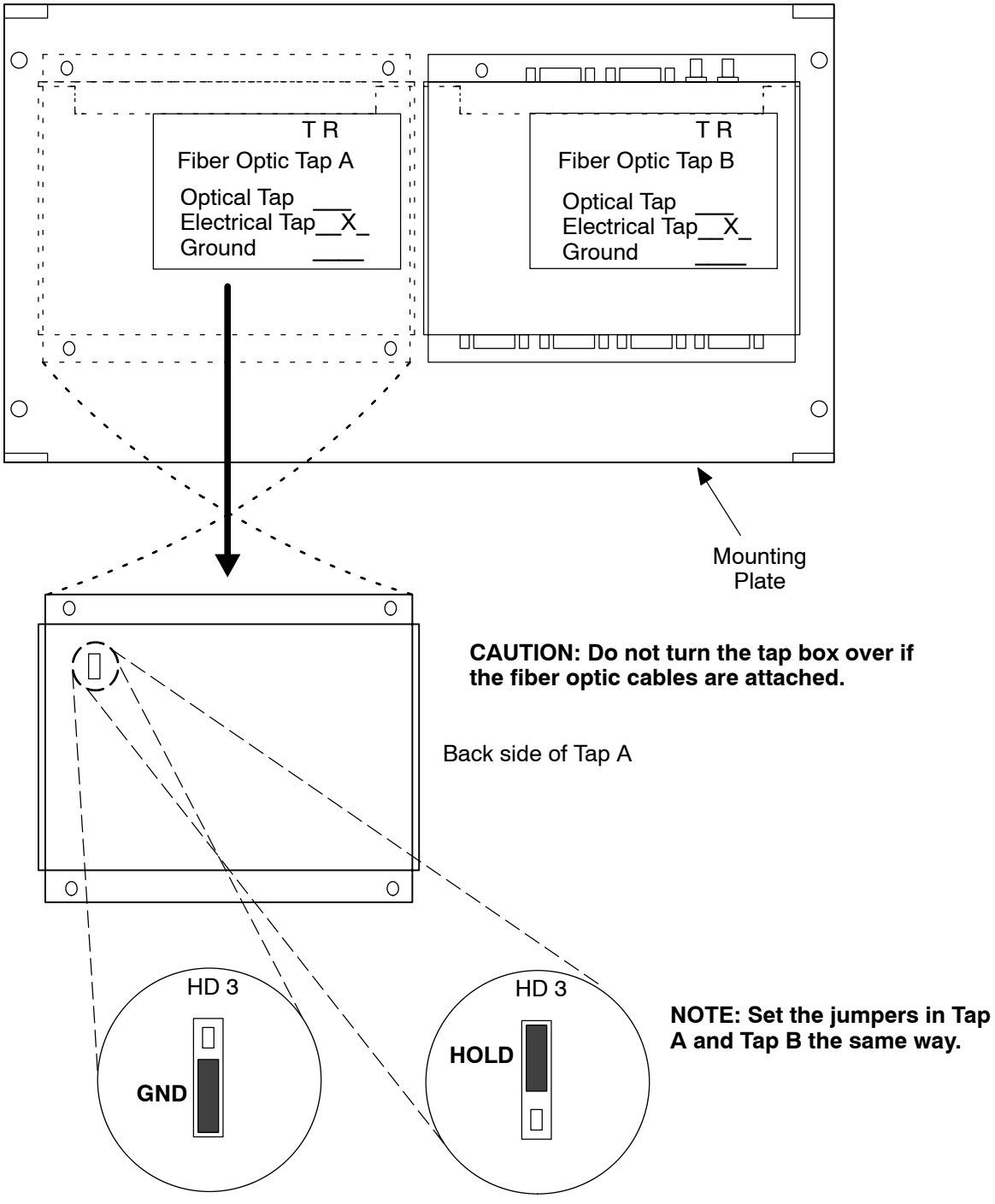


Figure 2.2.11. Grounding the Optical Tap Box

Fiber Optic Cable and Accessories

Each fiber optic cable has two separate fibers. One fiber is used to transmit data and one fiber is used to receive data. Fiber optic cables are used in pairs, called A and B. The A cable should be color coded green and the B cable should be color coded blue. The cable connectors can be marked with a felt-tip marker. Corresponding A and B tap boxes are marked with green and blue labels.

The fiber optic cable is terminated with ST connectors that have less than 0.7 dB loss per connector.

See the *Site Preparation and Installation Manual* (SP) for procedures to install fiber optic connectors.

WARNING

Use care when handling optical cables. The ends are subject to damage from chipping, dust, and dirt. The cable may be damaged if it is bent at too small a radius.

Installing Fiber Optic Connectors

A kit (1984–1189–0001) is available for splicing fiber optic cables. Refer to the instructions received with the kit for installing the fiber optic connector. Figure 2.2.12 shows the connector components.

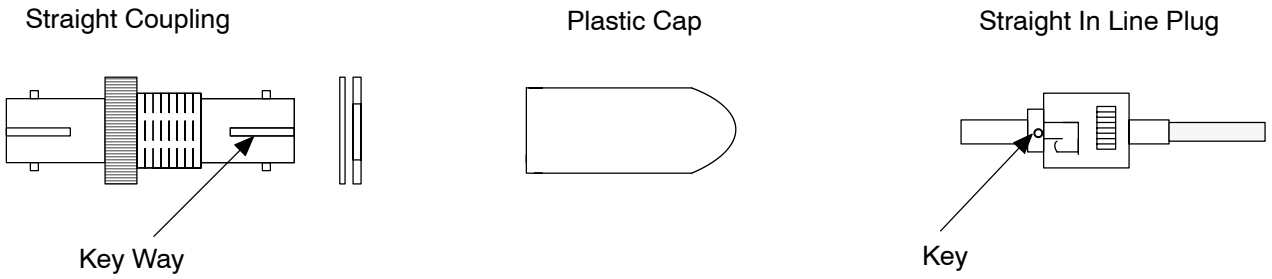


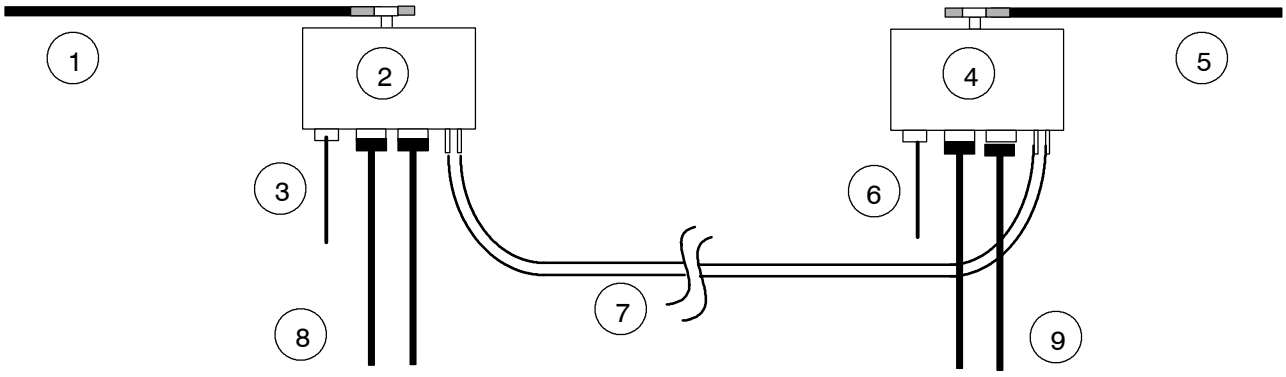
Figure 2.2.12. Fiber Optic Connector

Section 3:
Hybrid PeerWay

A hybrid PeerWay has electrical (twinax) segments and fiber optic segments. The PeerWay Extender (PX) allows creation of a hybrid PeerWay with both twinax and fiber optic segments. The PX transfers information between the twinax and the fiber optic segments and acts as a regenerative repeater. It also provides two standard PeerWay drops, which directly connect to the twinax segment. The PX is designed to be fully compatible with both twinax PeerWay products and fiber optic PeerWay products.

A pair of Highway Interface Adapters (HIA) can be used to allow communications between a twinax and a fiber optic PeerWay, but the two PeerWays each retain their individual set of node numbers.

Figure 2.3.1 shows insertion of a fiber optic link in a twinax PeerWay. The PXs are shown at the physical end of the twinax segments. Actually they can be located anywhere along the twinax run.

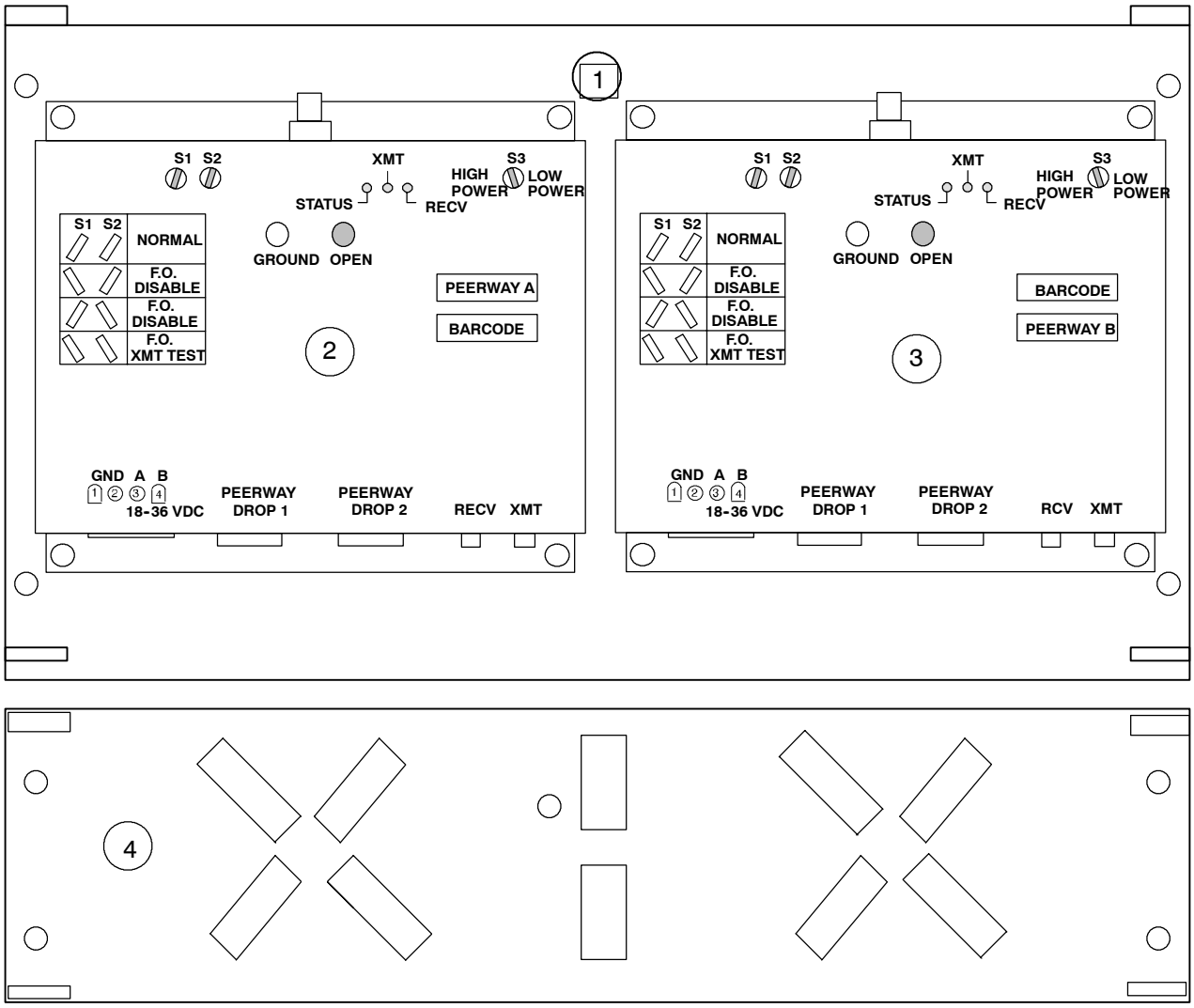


No.	Description	No.	Description
1	Twinax PeerWay cable	6	DC power cable (18–36 VDC)
2	PeerWay Extender (PX)	7	Fiber Optic PeerWay cable
3	DC power cable (18–36 VDC)	8	Peerway Drop Cables to devices
4	PeerWay Extender (PX)	9	Peerway Drop Cables to devices
5	Twinax PeerWay cable		

Figure 2.3.1. Sample Hybrid PeerWay

PeerWay Extender (PX)

A PeerWay Extender Tap Box Assembly consists of a PeerWay A PX (10P50930001), a PeerWay B PX (10P50960001), and a mounting plate (1984-0484-0002). FRSI recommends using a Fiber Optic Cable Tie Assembly (1984-2231-0001). A typical unit is shown in Figure 2.3.2.



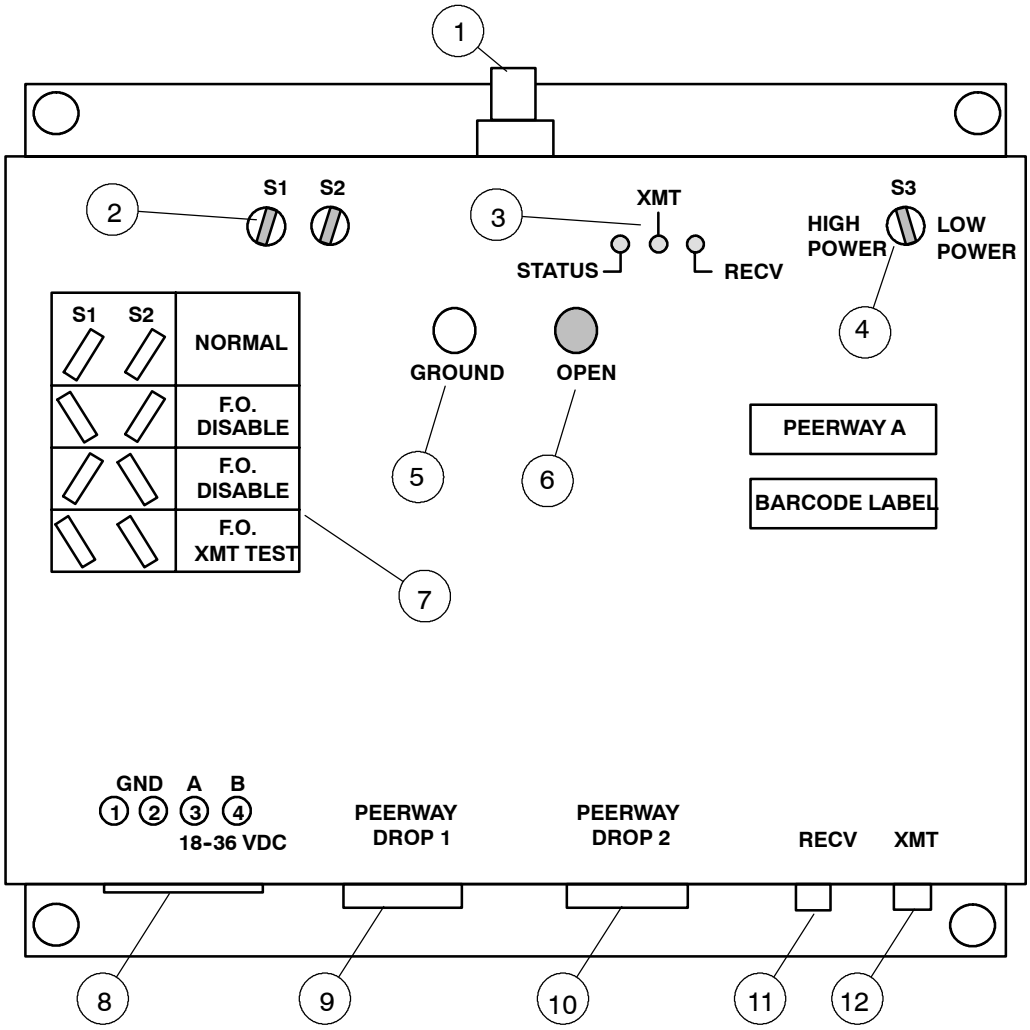
No.	Description	No.	Description
1	Mounting Plate	3	PX for PeerWay B
2	PX for PeerWay A	4	Fiber Optic Cable Tie Assembly

Figure 2.3.2. PeerWay Extender Tap Box Assembly

Table 2.3.1. PX Parts Replacement Data

Part No.	Replaces	Name	Comment
Tap A 10P50930001	10P52760001	Twinax Tap Box A	Provides only two PeerWay drops.
	1984-0488-0001	Twinax Tap Box A	Provides only two PeerWay drops.
	1984-3211-0001	Optical Tap Box A	Provides only two PeerWay drops. Cannot connect to Electrical Tap Boxes.
	1984-1191-0001	Optical Tap Box A	Provides only two PeerWay drops. Cannot connect to Electrical Tap Boxes.
Tap B 10P50960002	10P52760002	Twinax Tap Box B	Provides only two PeerWay drops.
	1984-0488-0002	Twinax Tap Box B	Provides only two PeerWay drops.
	1984-3211-0002	Optical Tap Box B	Provides only two PeerWay drops. Cannot connect to Electrical Tap Boxes.
	1984-1191-0002	Optical Tap Box B	Provides only two PeerWay drops. Cannot connect to Electrical Tap Boxes.

The parts of a PX are shown in Figure 2.3.3.



No.	Description	No.	Description
1	Twinax Peerway Connector	7	Label showing effect of Normal/Test switches
2	Normal/Test switches S1 and S2	8	DC power connector
3	LEDs	9	PeerWay Drop 1 connector
4	Fiber Optic output power switch (S3)	10	PeerWay Drop 2 connector
5	Tap Box grounding screw position	11	Fiber Optic receiver
6	Tap Box non-grounded screw position	12	Fiber Optic transmitter

Figure 2.3.3. PeerWay Extender (PX)

PX System Cabling

The PeerWay Extender is cabled as shown in Figure 2.3.4. Table 2.3.2 identifies the parts.

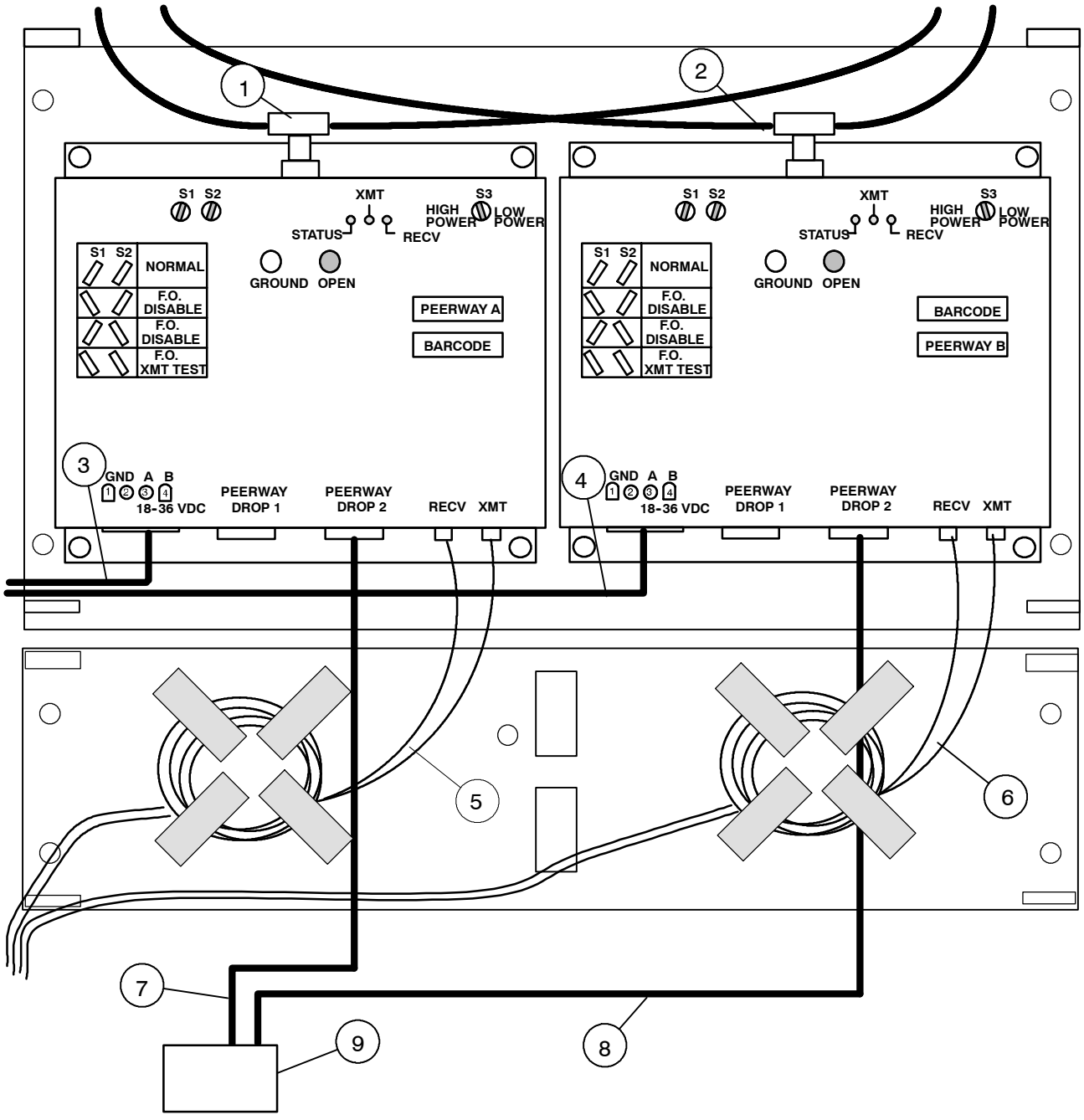


Figure 2.3.4. PX System Cabling

Table 2.3.2. PX System Cabling Components

No.	Description	No.	Description
1	Peerway A Twinax connector and cable	6	PeerWay B fiber optic cables and connectors
2	Peerway B Twinax connector and cable	7	PeerWay A Drop Cable to device
3	DC power cable for PX A	8	PeerWay B Drop Cable to device
4	DC power cable for PX B	9	Device connected to the PeerWay
5	Peerway A fiber optic cables and connectors		

Twinax Cables

Twinax cables are attached to the top of the unit by a “T” connector. Use a terminator if this tap box is at the end of the twinax run. If there are no twinax cables attached, you must put a terminator on the single twinax connector at the top of the unit. Use only one terminator.

CAUTION

The barrel of each twinax connector and terminator must be covered with an insulating sleeve to prevent inadvertent grounding of the twinax cable to the mounting plate.

Fiber Optic Cables

Fiber optic cables require strain relief near the connector. It is customary to leave about 3 meters (10 feet) of cable to allow replacement of the connector. FRSI recommends using Fiber Optic Cable Tie Assembly (1984-2231-0001).

DC Power Cable

A standard DC Bus to System Device cable (1984-0158-xxxx) can be used to connect system DC power to the tap box. Any other reliable source of DC in the range of 18 to 36 V can be used. A Mate N Lock™ connector (G11262-1004) is used.

CAUTION

The PX must be supplied with a reliable source of DC power. If the PX loses power, the PeerWay is broken into separate twinax segments at that point.

Drop Cables

Sandard PeerWay Drop Cables (1984-0473-xxxx) are used to connect devices to the tap box. Tighten the connector captive screws at both ends of the cable run.

NOTE: The PX can be powered through the Drop Cables but only if turning the devices off will not break the PeerWay by removing power from the PX.

Grounding the PX

Each tap box assembly must be grounded. Mounting the assembly in a properly grounded system cabinet grounds the assembly. If the assembly is mounted on a non-conducting surface, a ground wire must be run to the nearest system grounding point.

One tap box set (and only one tap box set) in each twinax PeerWay segment must have the twinax shield connected to chassis ground. To make the connection at the PX tap box set, move the screw from the OPEN position to the GROUND position. Move the screws on both tap boxes A and B. To make the connection at another tap box set, set the “SHIELD” jumper to “GND” on both tap boxes A and B.

A zero length twinax segment (a PX with no twinax attached) must have the screw set at GROUND on both A and B tap boxes.

PX LEDs

There are three LEDs as shown in Table 2.3.3.

Table 2.3.3. PX LEDs

LED	Meaning
STATUS (Yellow)	The PX is running and has adequate power applied.
XMT (Yellow)	Fiber Optic Transmit – ON (flickering) when messages are being transmitted on the fiber optic channel. ON continuously indicates a stuck transmitter or transmitter in test mode.
RECV (Yellow)	Fiber Optic Receive – ON (flickering) when messages are being received on the fiber optic channel. ON continuously indicates a stuck transmitter at the other end of the fiber or transmitter in test mode.

PX Switches

There are two sets of switches: S1 and S2 control the Normal/Test mode of operation; S3 controls the output power of the fiber optic transmitter. The switches are reached through holes in the faceplate.

Fiber Optic Power Switch

Switch S3 controls the power output of the fiber optic transmitter. At the HIGH POWER setting full transmitter power is output. At the LOW POWER setting the output is about 7 to 10 dB lower. This is used in place of an external attenuator.

Normal/Test Switches

The PeerWay Extender has three operating modes: normal, disabled, and test. The modes are controlled by switches S1 and S2. You must force PeerWay traffic to the other PeerWay before using either disable or test mode.

Normal Mode: When S1 and S2 are both thrown to the right, normal operation results.

Disabled Mode: When S1 and S2 differ, the twinax to fiber optic connection is turned off.

Test Mode: When S1 and S2 are both thrown to the left, the fiber optic transmitter sends a 50% duty cycle signal on the fiber. The Receive LED on all tap boxes connected to this fiber should be ON. This verifies that both transmitter and receiver are functioning within specification. Table 2.3.4 shows all cases.

Table 2.3.4. Normal/Test Switch Settings

S1 Position	S2 Position	Effect
Right	Right	Normal Mode
Right	Left	Disabled
Left	Right	Disabled
Left	Left	Fiber Optic Transmitter Test Mode

PX Fuses

Table 2.3.5 gives fuse data for the PX.

Table 2.3.5. PX Fuses

Fuse	FRSI Part No.	Littelfuse Part No.	Schurter Part No.	Characteristics
F1, F2	G50382-0009	273.125	MSF 034.4210	1/8 A 125 V Plug-In
F3	G50382-0019	273.001	MSF 034.4221	1 A 125 V Plug-In

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Section 1:
Multitube and Hardened Command Consoles and System Manager Station

This section covers the free standing operator interface portion of the Multitube Console, including the keyboards and CRT. The operator interface portion of the Hardened Command Console and System Manager Station is also covered here. The Hardened Command Console uses many of the same assemblies as the Multitube Console.

The Operator Interface (console) Card Cage and electronics are covered in Section 6 of this chapter. Peripheral devices (disk, tape, and printer) are covered in Sections 4 and 5 of this chapter. Maintenance and troubleshooting of the console is covered in chapters 9 and 10.

Figure 3.1.1 shows the Multitube Command Console operator interface. Figure 3.1.2 shows the System Manager Station. Figure 3.1.3 shows the interior of a Hardened Command Console.

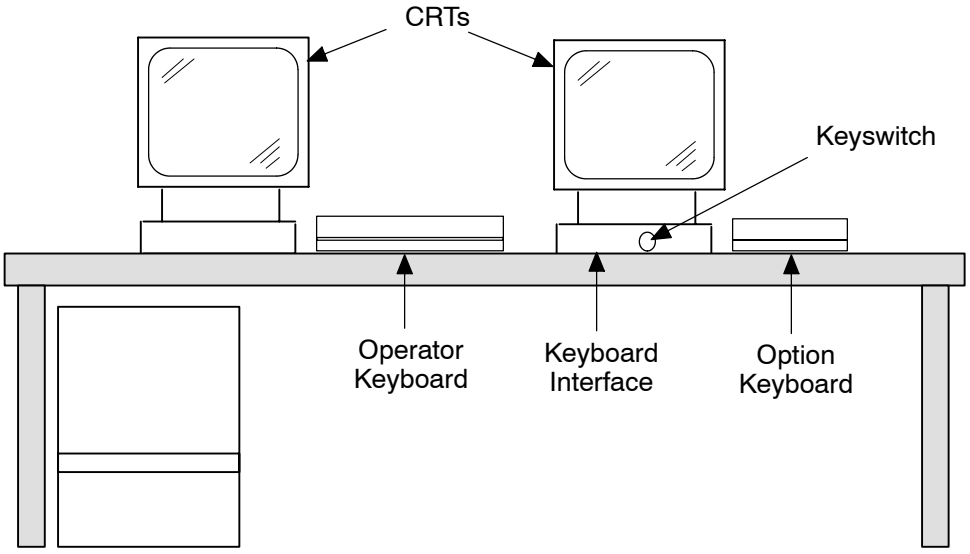
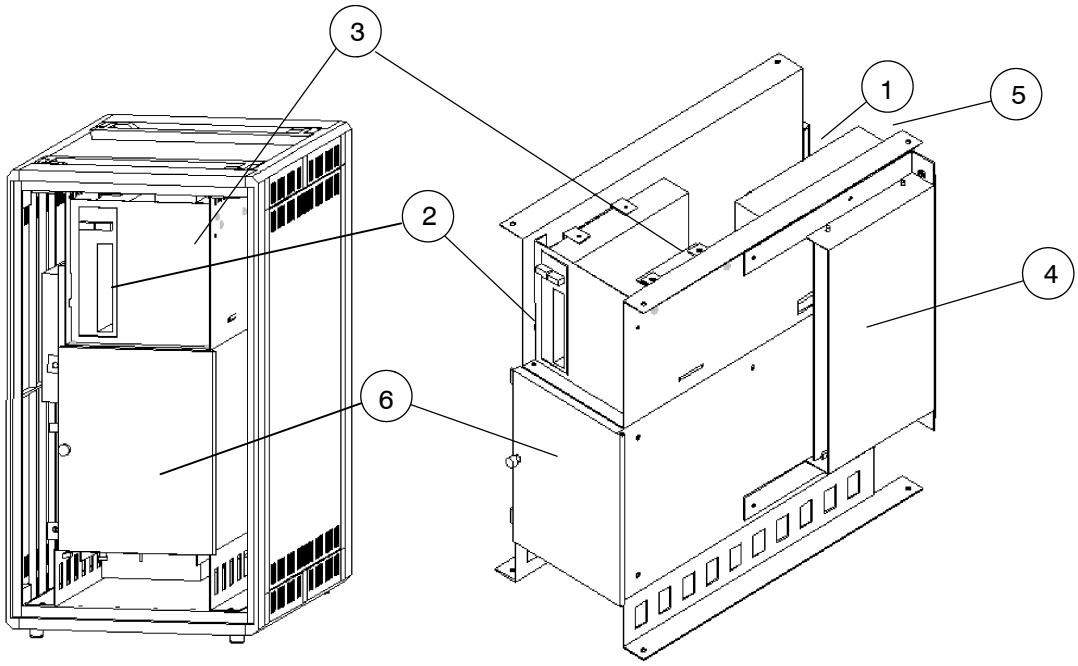


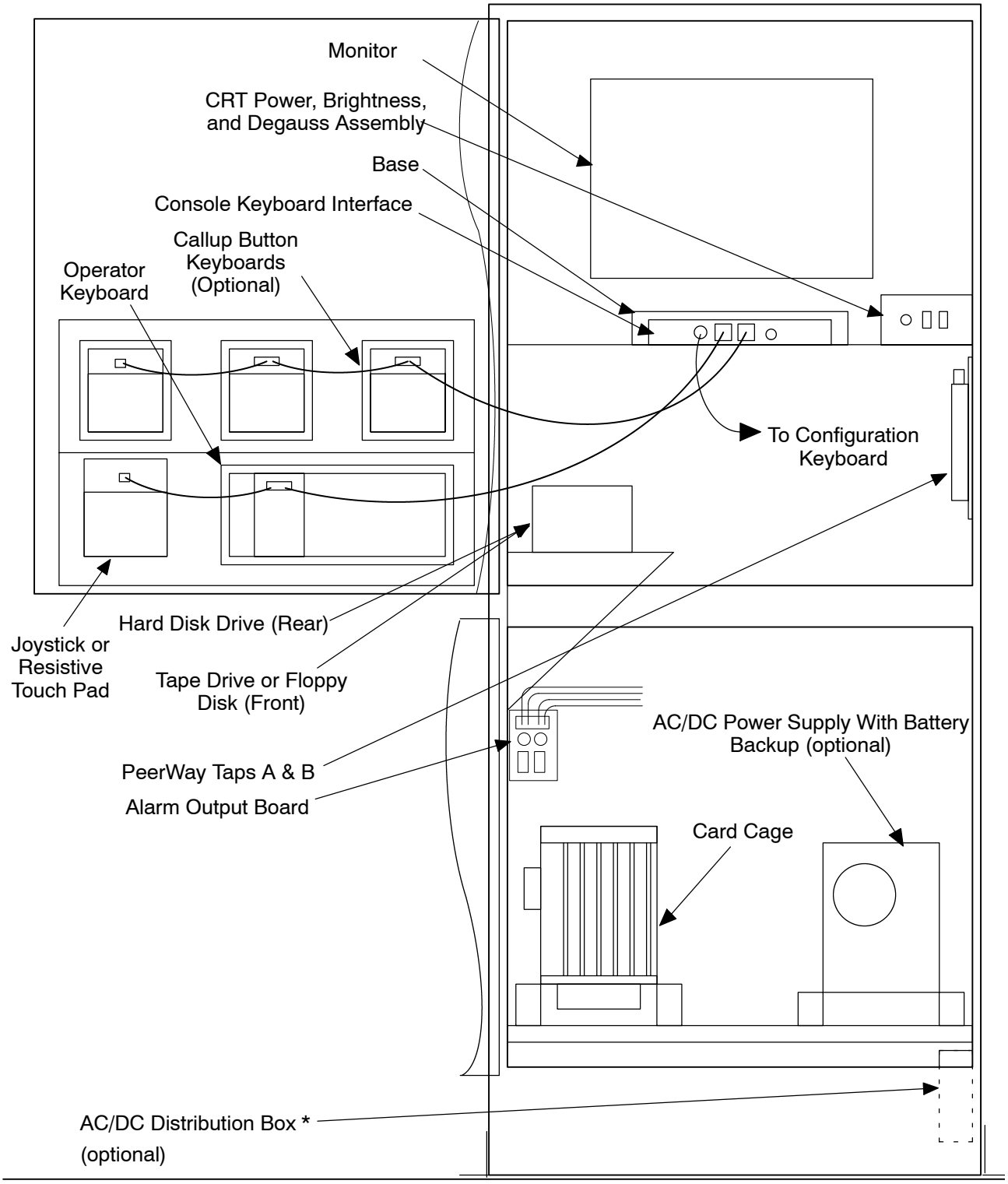
Figure 3.1.1. Multitube Command Console



Front Door Removed **Panels Removed**

No.	Description	No.	Description
1	PeerWay Tap	4	Keyboard/Video Interface (if internal mount)
2	Tape Drive	5	Power Supply (if present)
3	Disk Drive	6	OI Card Cage (door closed)

Figure 3.1.2. System Manager Station



* The AC distribution box for the optional air conditioner must be supplied separately by the customer and must be on a different circuit than the circuit powering the CRT and card dage electronics.

Figure 3.1.3. Hardened Command Console (Doors Open)

Multitube Command Console Keyboard Assemblies

The Multitube Console may have these keyboard assemblies:

- Alphanumeric keyboard (PC or QWERTY style):
  - Configuration Keyboard or Engineering Keyboard
  - Enhanced Engineering Keyboard (Combines Operator and Engineering Keyboard functions)
- Operator Keyboard Assembly (also called the Main Keyboard)
- Option Keyboard Assembly (with up to 3 units of 32 configurable keys each)
- Trackball Assembly
- Touchpad Assembly (Hardened Command Console only)
- Joystick (Hardened Command Console only)

The Keyboard Interface card connects these keyboard assemblies to the console electronics.

The Alarm Output Board provides console alarm signals as contact closures. See Section 5 of this chapter for details.

Multitube Command Console Keyboard Error Reporting

If a key is shorted or held down for more than 20 seconds, hardware alarm 090 will be issued. The message indicates the problem area by keyboard number (p) and key number (kkk):

Board: Key <p:kkk> is bad

Table 3.1.1 shows the keyboard number assignments for Multitube Command Console keyboards.

Table 3.1.1. Multitube Command Console Keyboard Numbers

Keyboard Number	Keyboard
1	Configuration Keyboard (Alphanumeric Keyboard)
2	Trackball Keyboard
3	Operator Keyboard
4	Callup Option Keyboard 1 (Left)
5	Callup Option Keyboard 2 (Middle)
6	Callup Option Keyboard 3 (Right)

Configuration Keyboard and Enhanced Engineering Keyboard

The Configuration Keyboard (1984-1654-000x), also known as the "Engineering Keyboard", is a PC compatible alphanumeric keyboard.

The Enhanced Engineering Keyboard (1984-2386-000x) combines the functions of the Configuration Keyboard and the Operator Keyboard.

NOTE: The Enhanced Engineering Keyboard requires software Version 15 or higher.

There are no field replaceable parts in either keyboard.

Upgrade kits are available to change -1654 keycaps to -2386 format. A Keycap Puller (1984-3017-000x) is available to assist in the keycap change operation. A new Keyboard Interface microprocessor or a new Keyboard Interface board may also be required for the upgrade.

Operator Keyboard

The Operator Keyboard comes in two versions:

- Main Keyboard/Trackball (1984-1634-000x)
- Main Keyboard/Trackball/Option (1984-2372-000x)

Subassemblies are available to replace the keyboard tops for each of the three component keyboards. The subassemblies are without base or cable. Keyboard Electronics boards are also available. See the individual keyboard assemblies listed below for details.

A single elevated base is standard issue. Separate bases for each subassembly are available for the Main, Trackball, and Option Keyboards.

Main Keyboard

The Main Keyboard is the flat panel, membrane key part of the Operator Keyboard assembly. The keyboard top may be replaced with the Main Keyboard Replacement Subassembly (1984-1695-000x). The subassembly has no base or cable.

The Main Keyboard uses the Keyboard Electronics board (1984-2871-000x or 1984-1970-000x). They are completely interchangeable.

NOTE: The same Keyboard Electronics board (with different jumper settings) is also used in the Option Keyboard.

Table 3.1.2 gives parts replacement data.

Table 3.1.2. Main Keyboard Parts Replacement

Part	Part No.	Replaces	Characteristics
Keyboard Electronics 68HC05	1984-2871-000x	1984-1970-000x	Keyboard Electronics boards are completely interchangeable
Keyboard Electronics	1984-1970-000x	1984-2871-000x	Keyboard Electronics boards are completely interchangeable
Main Keyboard Replacement Subassembly	1984-1695-000x	Keyboard top	Without base or cable

Jumpers HD1 through HD4 (or J1 through J4) on the Keyboard Electronics board must be set to indicate that the board is being used with the Main Keyboard. Jumper positions are shown in Table 3.1.3.

NOTE: The table printed on some boards refers to HD1-HD4 as J1-J4.

Table 3.1.3. Keyboard Electronics Board Jumper Positions for Use in Main Keyboard

Board use	HD1 (J1)	HD2 (J2)	HD3 (J3)	HD4 (J4)
Main Keyboard	1-2	1-2	2-3	2-3

Trackball Keyboard Assembly

The Trackball Assembly (1984–1631–000x) is a part of the Operator Keyboard or of a free standing trackball keyboard. The Trackball top may be replaced with the Trackball Keyboard Replacement Subassembly. The subassembly is without base or cable. Two versions exist:

- 10P5324000x CE compliant. For all consoles.
- 1984–1693–000x For all except CE-compliant consoles.

NOTE: For a CE-compliant console, be sure to replace CE-compliant parts only with CE-compliant parts.

The Trackball Keyboard Replacement Subassembly includes a Trackball Keyboard Electronics Board.

The trackball is contained in a small black box (1984–1653–000x). Two versions are available: –0003 for normal use and –0004 for severe environments.

NOTE: Most trackball problems can be cured by cleaning the trackball. See Chapter 9, Maintenance, for instructions.

Table 3.1.4 gives parts replacement data.

Table 3.1.4. Trackball Keyboard Parts Replacement

Part No.	Name	Replaces	Characteristics
10P5324000x	Trackball Keyboard Replacement Subassembly	1984–1693–000x	CE compliant. Useable in any console. Replaces the keyboard top only. Has no base or cable
1984–1693–000x	Trackball Keyboard Replacement Subassembly	10P5324000x	Not for a CE-compliant console. Replaces the keyboard top only. Has no base or cable
10P5285000x	Keyboard Electronics Board 68HCC05	1984–1975–000x 1984–2662–000x	CE compliant. Can replace any other keyboard electronics board
1984–2662–000x	Keyboard Electronics Board 68HCC05	10P5285000x 1984–1975–000x	Keyboard electronics boards are Interchangeable except for CE compliance
1984–1975–000x6	Keyboard Electronics Board	10P5285000x 1984–2662–000x	Keyboard electronics boards are Interchangeable except for CE compliance
1984–1653–0003 Normal Trackball	Trackball	Trackball	Replaces the “black box” containing the trackball
1984–1653–0004 Teflon Sealed Trackball	Trackball	–	The entire 1984–1631–0006 Keyboard Assembly must be replaced if the sealed trackball fails

Option Keyboard

The Option Keyboard (1984-1632-000x), with 32 Callup Buttons, is a part of the Operator Keyboard or a free standing keyboard. The keyboard top may be replaced with the Option Keyboard Replacement Subassembly (1984-1694-000x). The subassembly is without base or cable.

The Option Keyboard uses Keyboard Electronics board 1984-2871-000x or 1984-1970-000x. They are completely interchangeable. The same board (with different jumper settings) is also used in the Main Keyboard. Table 3.1.5 provides parts replacement data.

NOTE: To maintain CE compliance, replace subassemblies only with subassemblies bearing the CE mark.

Table 3.1.5. Option Keyboard Electronics Board Parts Replacement

Part No.	Replaces	Name on PWA	Characteristics
1984-2871-000x	1984-1970-000x	KEYBOARD ELECTRONICS	Keyboard Electronics boards are completely interchangeable
1984-1970-000x	1984-2871-000x	KEYBOARD ELECTRONICS	Keyboard Electronics boards are completely interchangeable

Jumpers on the Keyboard Electronics board must be set to indicate that the board is being used with Option Keyboard 1, 2, or 3. Jumper positions are shown in Table 3.1.6.

NOTE: The table printed on some boards refers to HD1-HD4 as J1-J4.

Table 3.1.6. Keyboard Electronics Board Jumper Positions

Usage	HD1 (J1)	HD2 (J2)	HD3 (J3)	HD4 (J4)
Option Keyboard 1	1-2	1-2	1-2	2-3
Option Keyboard 2	1-2	1-2	2-3	1-2
Option Keyboard 3	1-2	1-2	1-2	1-2

Touchpad

The Touchpad (1984–2844–000x or 1984–2321–000x) is used with the Hardened Command Console. It is marked “TOUCH PANEL” on the printed wiring assembly (PWA). The touchpad is sometimes called a “Scratchpad”.

The touchpad is used in conjunction with a membrane keyboard (1984–2335–000x) and the Touchpad Keyboard Electronics Board (1984–1981–000x).

NOTE: The touchpad is obsolete and should be replaced with a Joystick.

Table 3.1.7 provides replacement data.

Table 3.1.7. Touchpad Replacement

Item	Part No.	Characteristics
Touchpad	1984–2321–000x	A Touchpad should be replaced with a Joystick upgrade kit.
Touchpad	1984–2844–000x	A Touchpad should be replaced with a Joystick upgrade kit.
Touchpad Keyboard Electronics Board	1984–1981–000x	A Touchpad Keyboard Electronics Board should be replaced with a Joystick upgrade kit.
Keyboard, Cursor Control (Modified)	1984–2335–000x	The membrane keyboard may be replaced with any dash number (–000x) keyboard assembly or with a Joystick upgrade kit.

Joystick

The Joystick (1984–3038–000x) is used with the Hardened Command Console. It replaces the Touchpad. Replacement requires use of a Joystick Upgrade Kit (1984–3040–000x). The upgrade kit contains a joystick, a new membrane keyboard, a Trackball Electronics Board, and miscellaneous hardware. The Trackball Electronics Board replaces the Touchpad Keyboard Electronics Board.

The Joystick uses either the Trackball 68HC05 (10P5285000x or 1984–2662–000x) or the Trackball Keyboard (1984–1975–000x) keyboard electronics boards. They are completely interchangeable. The Joystick cannot be used in a CE-compliant console.

The Joystick is used in conjunction with a membrane keyboard (1984–2335–000x). The keyboard dash number must be –0003 or higher.

NOTE: The Joystick is sensitive to radio frequency interference in the 400–500 MHz range. For example, a walkie-talkie operated within one foot of the Joystick may cause the cursor to move across the screen.

Table 3.1.8 provides replacement data.

Table 3.1.8. Joystick Parts Replacement

Item	Part No.	Replaces	Characteristics
Joystick	1984–3038–000x	Itself	
Joystick Upgrade Kit	1984–3040–000x	1984–2844–000x 1984–2321–000x	Replaces the touchpad
Trackball 68HC05 Keyboard Electronics Board	10P5285000x	1984–2662–000x 1984–1975–000x	Keyboard electronics board CE compliant
Trackball 68HC05 Keyboard Electronics Board	1984–2662–000x	10P5285000x 1984–1975–000x	Keyboard electronics board
Trackball Keyboard Electronics Board	1984–1975–000x	1984–2662–000x	Keyboard electronics board

Multitube Command Console Keyboard Electronics

The keyboard assemblies use these electronics boards:

- Keyboard Electronics Board
- Trackball Keyboard Electronics Board
- Touchpad Keyboard Electronics Board

Keyboard Electronics Board

The Keyboard Electronics board (1984-2871-000x or 1984-1970-000x) is used in both the Main Keyboard and the Option Keyboard. Both are marked “KEYBOARD ELECTRONICS” on the PWA. They differ in the microprocessor used but they are completely interchangeable.

Jumpers on the Keyboard Electronics board must be set to indicate whether the board is being used with the Main Keyboard or with Option Keyboard 1, 2, or 3. Jumper positions are shown in Table 3.1.9.

The jumpers on 1984-1970-000x are concealed. The board must be removed for access to the jumpers.

NOTE: The table printed on some boards refers to HD1-HD4 as J1-J4.

Table 3.1.9. Keyboard Electronics Board Jumper Positions

Usage	HD1 (J1)	HD2 (J2)	HD3 (J3)	HD4 (J4)
Main Keyboard	1-2	1-2	2-3	2-3
Option Keyboard 1	1-2	1-2	1-2	2-3
Option Keyboard 2	1-2	1-2	2-3	1-2
Option Keyboard 3	1-2	1-2	1-2	1-2

Table 3.1.10 provides replacement data.

Table 3.1.10. Keyboard Electronics Board Parts Replacement

Item	Part No.	Replaces	Characteristics
Keyboard Electronics board	1984-2871-000x	1984-1970-000x	Completely interchangeable
Keyboard Electronics board	1984-1970-000x	1984-2871-000x	Completely interchangeable

Trackball Keyboard Electronics Board

The Trackball Assembly and the Joystick use either:

- 10P5285000x marked “TRACKBALL 68HC05” on the PWA
- 1984–2662–000x marked “TRACKBALL 68HC05” on the PWA
- 1984–1975–000x marked “TRACKBALL KEYBOARD” on the PWA.

The boards are fully interchangeable except that only the 10P5285000x can be used in a CE-compliant console. Table 3.1.11 gives parts replacement data.

Table 3.1.11. Trackball Electronics Board Replacement

Name on PWA	Part No.	Replaces	Characteristics
TRACKBALL 68HC05	10P5285000x	1984–2662–000x 1984–1975–000x	Boards are interchangeable except in CE-Complaint consoles
TRACKBALL 68HC05	1984–2662–000x	10P5285000x 1984–1975–000x	Boards are interchangeable except in CE-Complaint consoles
TRACKBALL KEYBOARD	1984–1975–000x	10P5285000x 1984–2662–000x	Boards are interchangeable except in CE-Complaint consoles

Touchpad Keyboard Electronics Board

The Touchpad Keyboard Electronics board (1984–1981–000x) is mounted behind the touchpad. It is marked “TOUCHPAD KEYBOARD” on the PWA.

NOTE: If the Touchpad Keyboard Electronics board requires replacement, the touchpad should be replaced with a joystick.

When a Touchpad is replaced by a Joystick, the Touchpad Keyboard Electronics board must be replaced with a Trackball Keyboard Electronics board. The replacement board is part of the Joystick upgrade kit (1984–3040–000x).

Multitube Command Console Keyboard Interface

The Keyboard Interface connects the keyboard assemblies to the console electronics.

- Password Security Software:
  - 10P50842004 (CE-Compliant Console)
  - 1984-3222-2004
- Standard Keyswitch:
  - 10P50840004 (CE-Compliant Console)
  - 1984-3222-0004 (also supports dual keyswitch option)
  - 1984-2889-0004
  - 1984-1978-000x (without video isolation)
- Remote Keyswitch
  - 1984-3222-1004
  - 1984-2889-1004

Table 3.1.12 shows parts replacement for the Keyboard Interface. Only CE-compliant boards can be used in CE-compliant consoles.

Table 3.1.12. Keyboard Interface Parts Replacement

Part No.	Replaces	Characteristics
10P50842004	1984-3222-2004	CE-compliant console Password Security Software
1984-3222-2004	None	Password Security Software
1984-3222-1004	1984-2889-1004	Remote Keyswitch (Uses 1984-3267-xxxx Remote Keyswitch Cable)
10P50840004	1984-3222-0004	CE-compliant console Standard Keyswitch only
1984-3222-0004	1984-2889-0004 1984-1978-000x	Standard Keyswitch or Dual Keyswitch (Uses 1984-3223-xxx Dual Keyswitch Cable)
1984-2889-0004	1984-1978-000x	Standard Keyswitch or Dual Keyswitch
1984-1978-000x	None	Standard Keyswitch No video isolation
1984-2889-1004	None	Remote Keyswitch (with pigtail cable)

Password Keyboard Interface

Keyboard Interfaces used with password security software have no keyswitch or connector for keyswitches.

Keyboard Interface 10P50842004 is used with password security software in the Console.

- 10P50842004 marked “KEYBD INT./ VIDEO ISOLATOR” on the PWA, this card is CE Compliant
- 1984-3222-2004 marked “KEYBD INTERFACE/VIDEO ISOLATOR” on the PWA

Figure 3.1.4 shows connections for these cards.

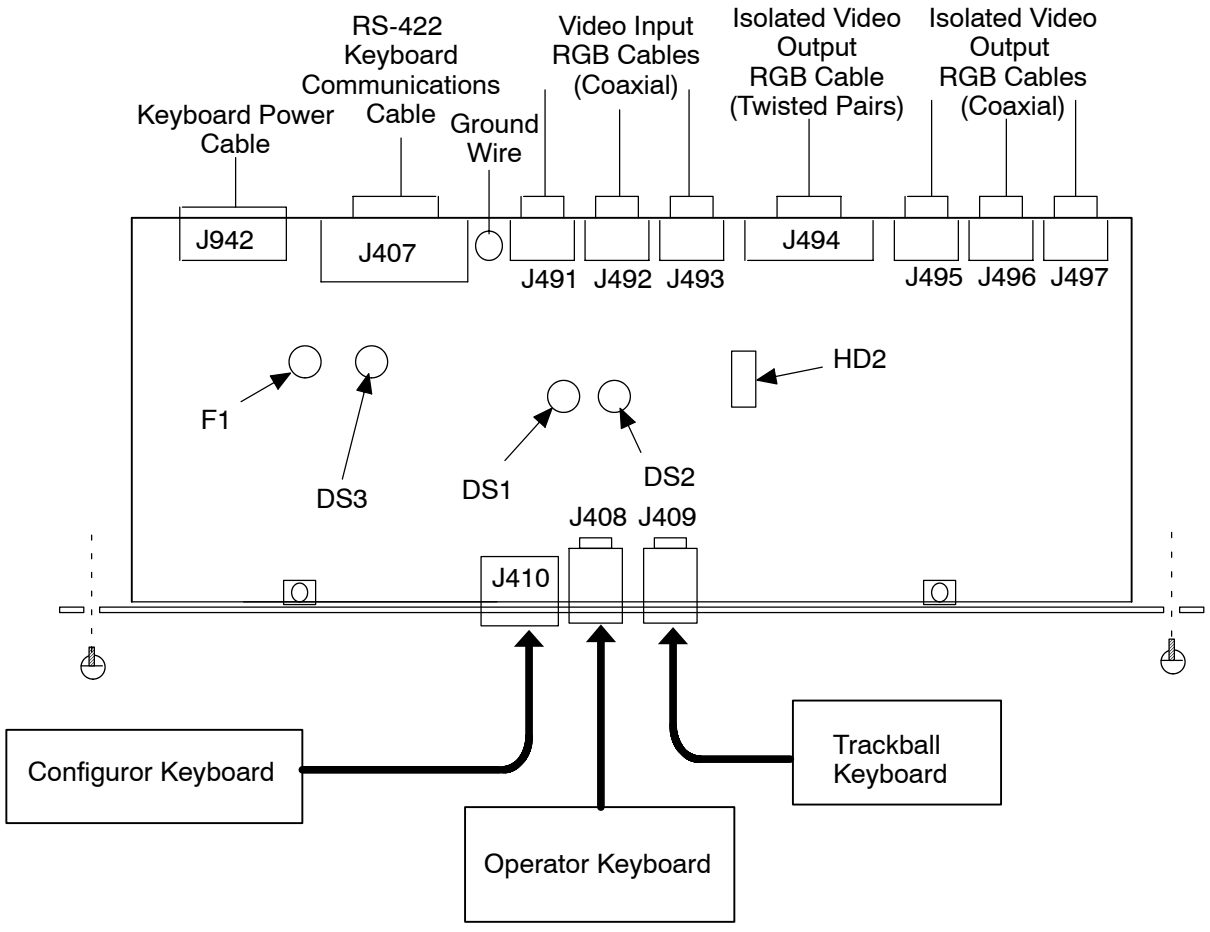


Figure 3.1.4. Typical 10P50842004 and 1984-3222-2004 Keyboard Interface Connections

Standard Keyswitch Keyboard Interface

The standard keyswitch function is provided with video isolation by:

- 10P50840004 (CE compliant)
- 1984-3222-0004

The dual keyswitch option is provided with video isolation by:

- 1984-3222-0004

The standard keyswitch function is provided with video isolation by:

- 1984-2889-0004

The standard keyswitch function is provided without video isolation by:

- 1984-1978-000x

10P50840004
1984-3222-0004

Keyboard Interface 10P50840004 is CE compliant. It does not support the dual keyswitch option.

Keyboard Interface 1984-3222-0004 is used for standard keyswitch applications and for the dual keyswitch option. In the standard keyswitch application, there is a jumper wire in J414. In the dual keyswitch option, a 1984-3223-xxxx “Cable, Keyboard Interface to Dual Keyswitch”, is plugged into J414. This cable provides the dual keyswitch.

Figure 3.1.5 shows the card and connections.

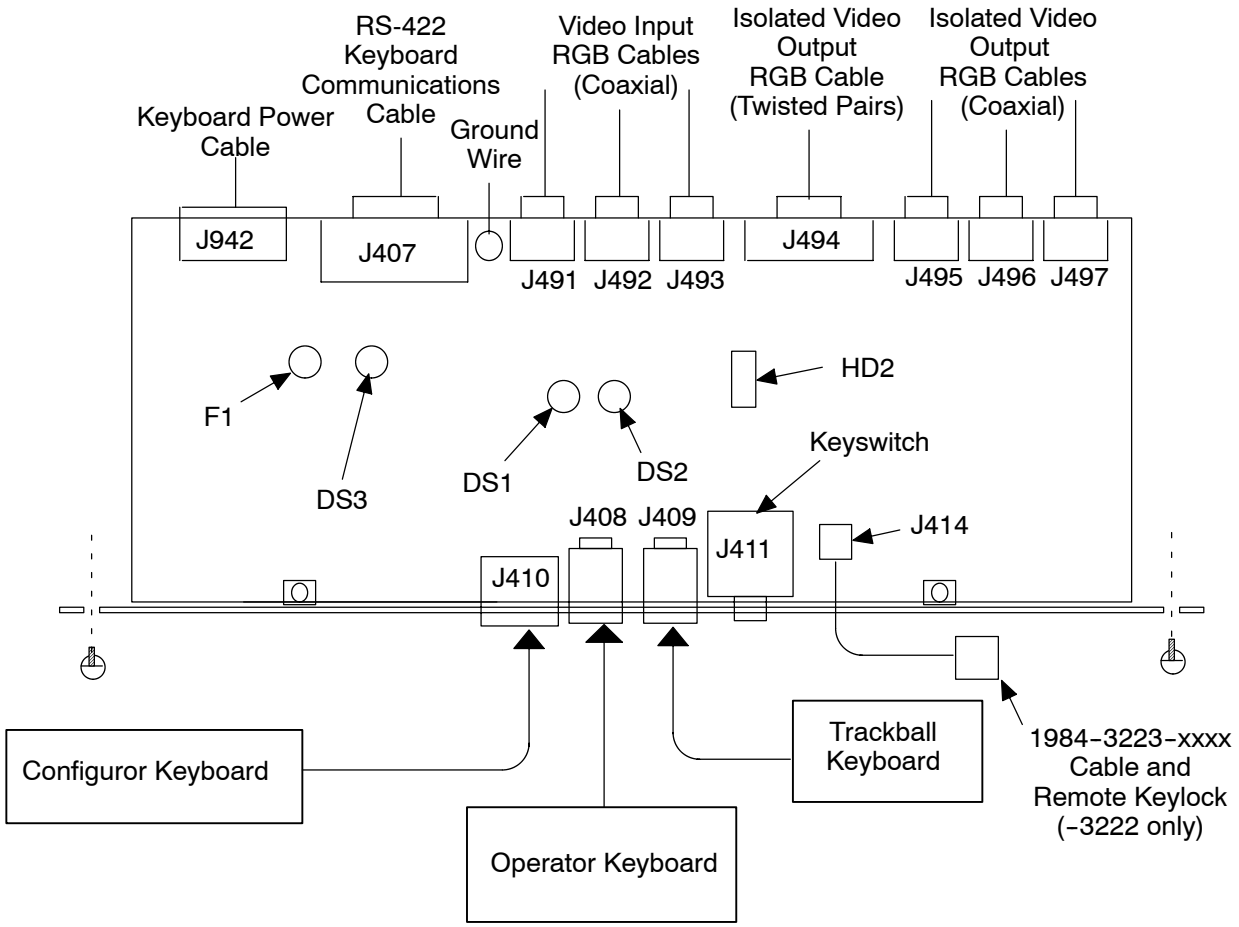


Figure 3.1.5. Typical 10P50840004 and 1984-3222-0004 Keyboard Interface Connections

1984-2889-0004

Keyboard Interface 1984-2889-0004 is used for standard keyswitch applications. The card provides video isolation.

Figure 3.1.6 shows typical connections.

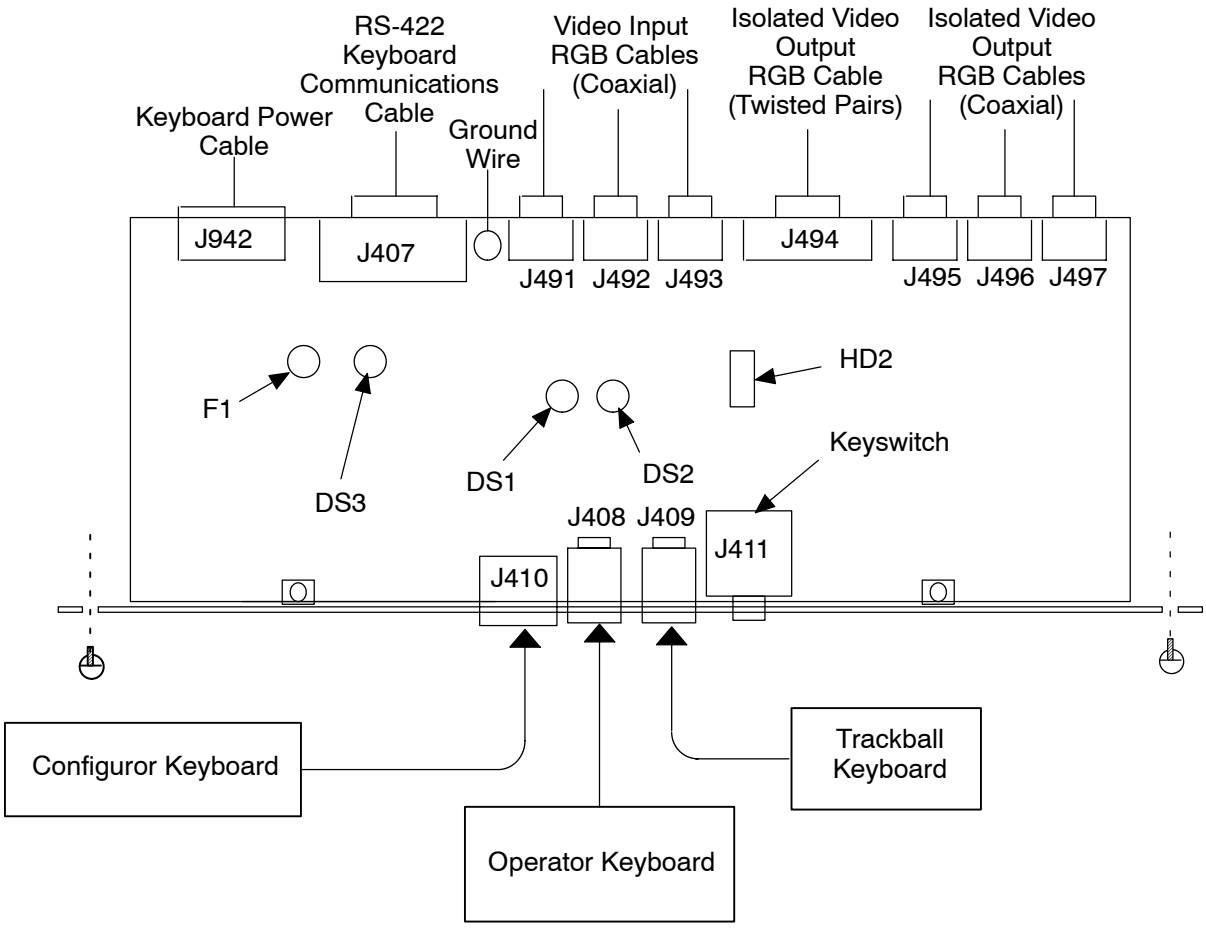


Figure 3.1.6. Typical 1984-2889-0004 Keyboard Interface Connections

1984-1978-000x

Keyboard Interface 1984-1978-0004 is used for standard keyswitch applications. The card does not provide video isolation.

Figure 3.1.7 shows typical connections.

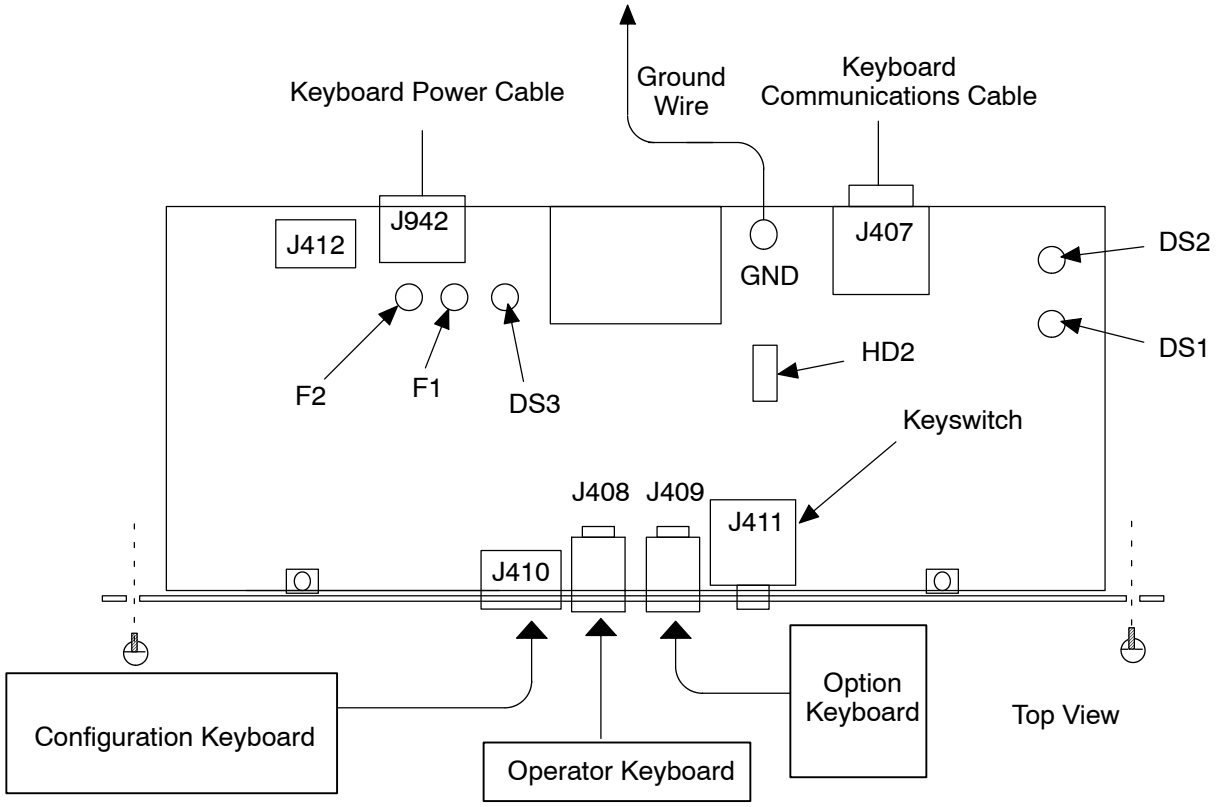


Figure 3.1.7. Typical 1984-1978-000x Keyboard Interface (Without Video Isolation) Connections

Remote Keyswitch Keyboard Interface

The remote keyswitch option is supported by:

- 1984-3222-1004
- 1984-2889-1004

1984-3222-1004

Keyboard Interface 1984-3222-1004 is used with the remote keyswitch option. No keyswitch is mounted on the card. A 1984-3267-xxxx, "Cable, Keyboard Interface to Remote Keylock", plugs into J415 to provide the remote keyswitch. A wire jumper must be in J414.

Figure 3.1.8 shows the normal connections.

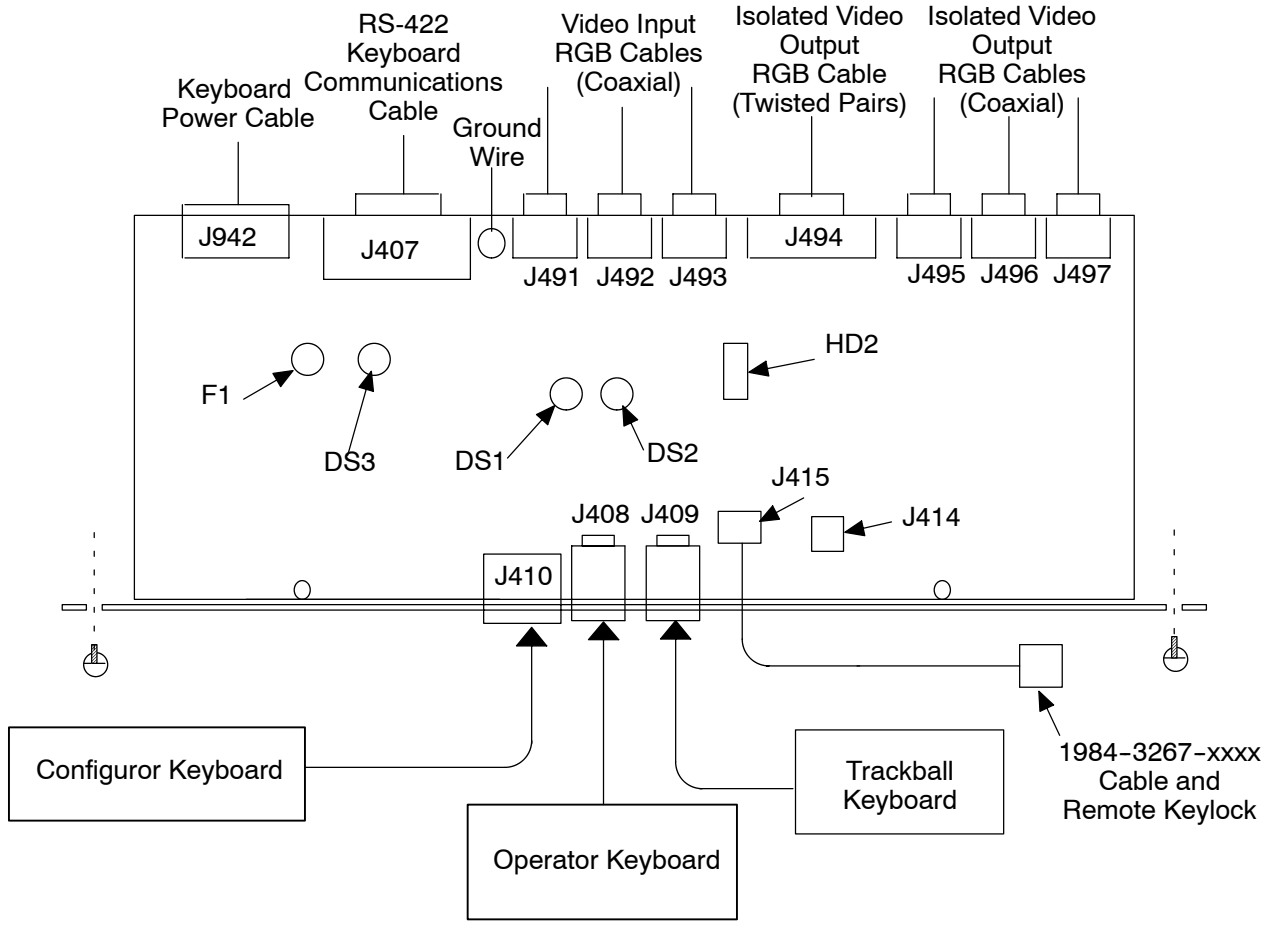


Figure 3.1.8. Typical 1984-3222-1004 Remote Keyswitch Keyboard Interface Connections

NOTE: When this card replaces 1984-2889-0004, a 1984-3297-xxxx "Cable, Keyboard Interface to Keyswitch Cable Assembly" is required. The adaptor cable plugs into J415 to replace the short cable soldered onto the -2889. The original 1984-3067-xxxx cable with keylock is plugged into the adaptor cable as shown in Figure 3.1.9.

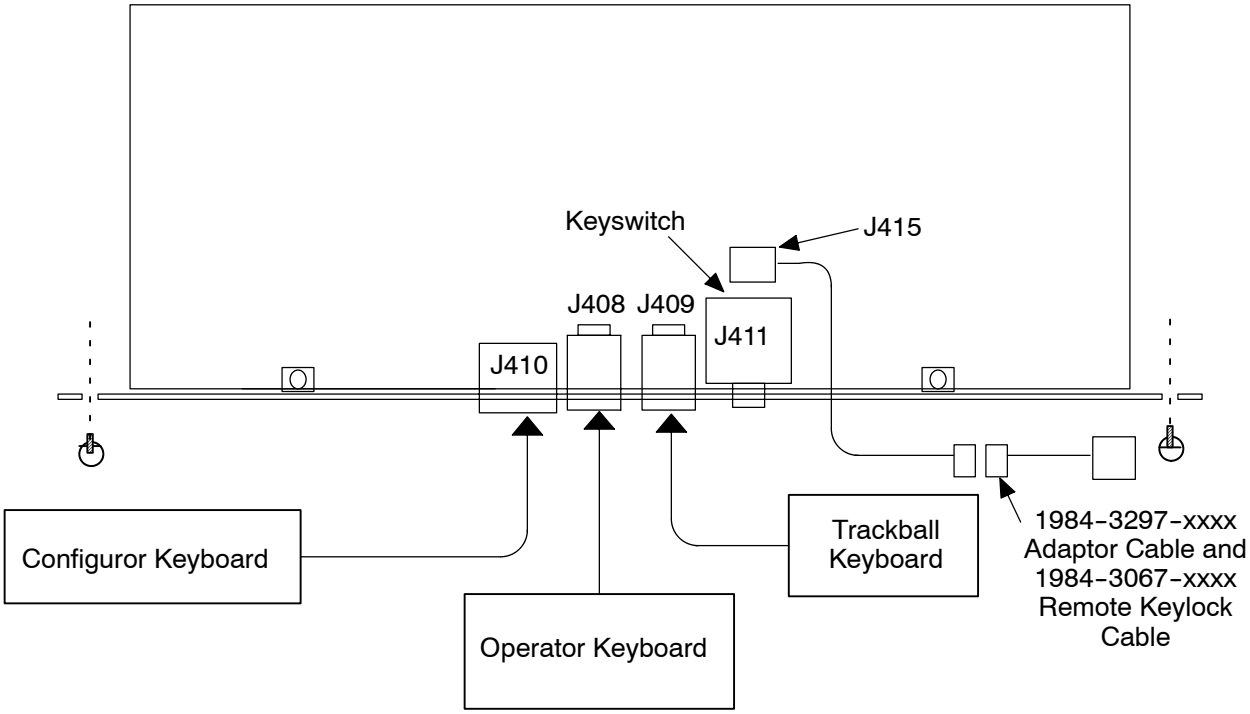


Figure 3.1.9. Typical 1984-3222-1004 Replacing 1984-2889-1004

1984-2889-1004

Keyboard Interface 1984-2889-1004 provides the remote keyswitch function with the aid of a short cable soldered into the J411 (keyswitch) position. A 1984-3067-xxxx “Cable, Keyboard Interface to Remote Keylock” is plugged into the socket on the short cable.

Figure 3.1.10 shows this use.

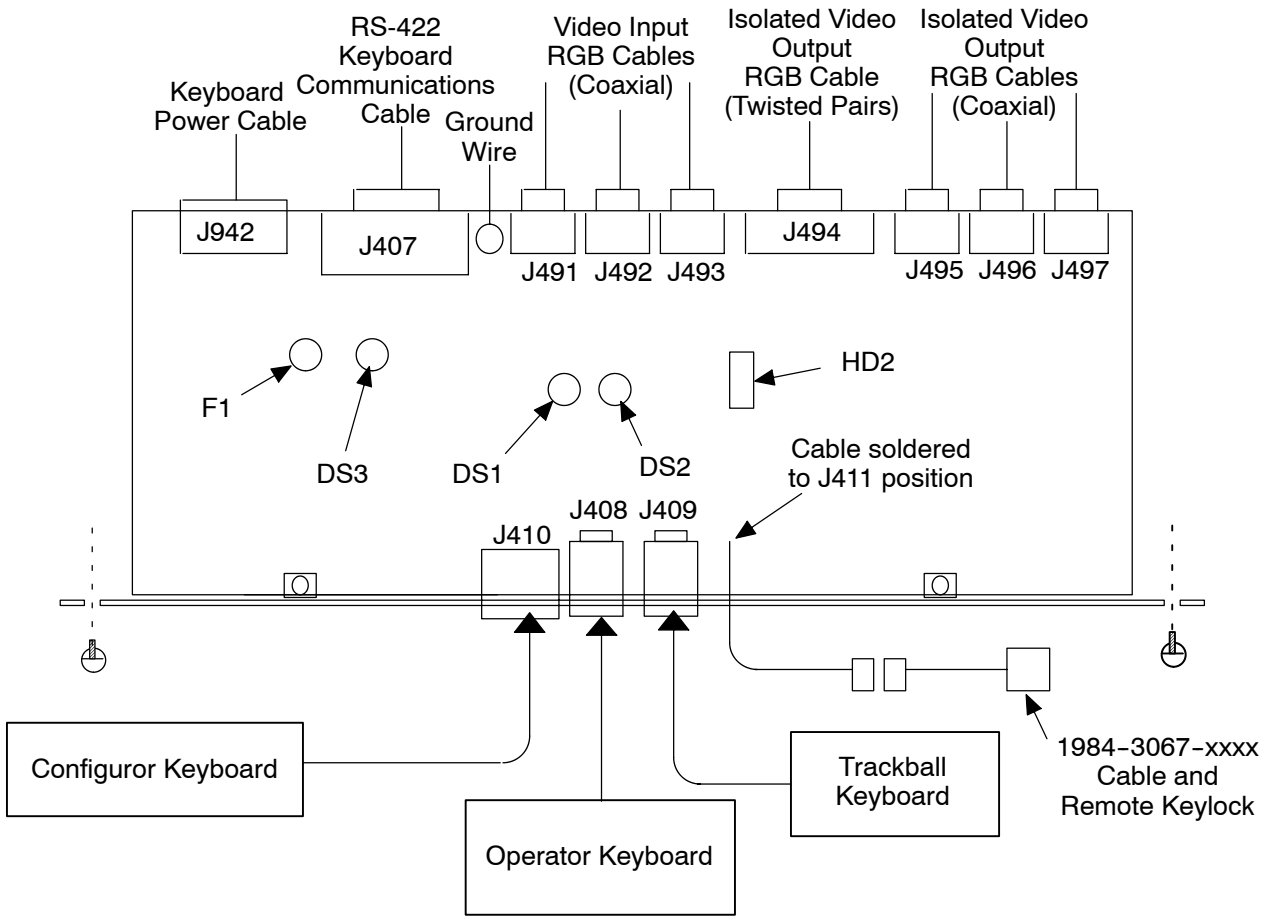


Figure 3.1.10. Typical 1984-2889-1004 Remote Keyswitch Keyboard Interface Connections

Keyboard Interface Access

❑ **To access the Keyboard Interface card:**

1. A portion of the connection cabling is typically routed through the legs of the Multitube Command Console table. To access the interior of the table legs, you must remove the table side panels. To remove a side panel, lift the panel up an inch or two, and then pull out.

CAUTION

The console Keyboard Interface contains electrostatic sensitive devices. Use a grounding wrist strap while working with the card.

2. Remove the console Keyboard Interface card from the monitor base by removing the two screws at the front of the console base and pulling out the assembly. Figure 3.1.11 shows the screw locations.

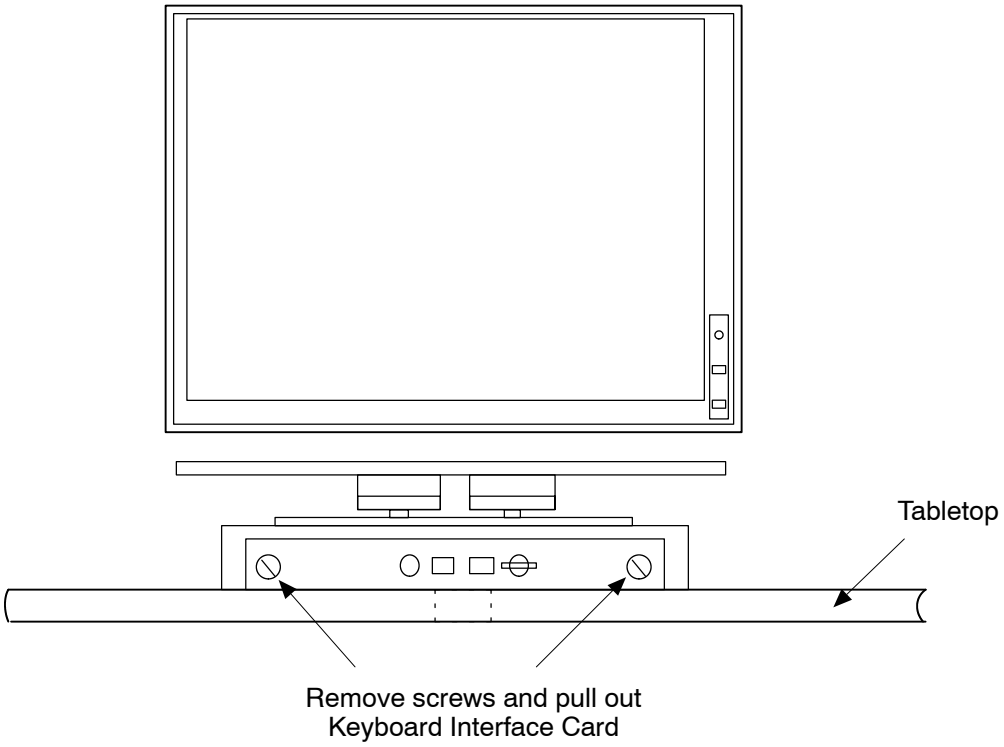


Figure 3.1.11. Removing the Console Keyboard Interface

Keyboard Interface LEDs

The 10P5084x00x, 1984–3222–x00x and 1984–2889–000x Keyboard Interface cards have three LEDs. Table 3.1.13 shows their meanings.

Table 3.1.13. Keyboard Interface LEDs

LED	Color	Meaning
DS1	Yellow	Flashes when receiving data from the printer interface
DS2	Yellow	Flashes when sending data to the printer interface
DS3	Red	Fuse F1 is blown

Keyboard Interface Jumper

The 10P5084x00x, 1984–3222–x00x and 1984–2889–000x Keyboard Interface cards have one jumper that indicates the software revision level loaded in the console.

1984–3222–x00x also has a jumper wire in J414 unless the –0004 dual keyswitch option is installed. Table 3.1.14 gives the jumper settings.

Table 3.1.14. Keyboard Interface Jumper Setting

Jumper Position	Function
HD2 1–2 12.86↓	Console software is at revision 12.86 or lower
HD2 2–3 12.90↑	Console software is at revision 12.90 or higher
J414 Jumper wire	1984–3222–0004 only Standard keyswitch application
J414 Dual keyswitch cable	1984–3222–0004 only Dual keyswitch application

Keyboard Interface Fuses

Table 3.1.15 provides fuse data for the Keyboard Interface cards.

Table 3.1.15. Keyboard Interface Fuses

Part No.	Name on PWA	Fuse	FRSI Part No.	Schurter Part No.	Littelfuse Part No.	Characteristics
10P5084x00x 1984-3222-000x 1984-2889-000x	Keybd Interface/ Video Isolator	F1	G50382-0021	MSF 034.4224	273002	2 A 125 V Plug-In
1984-1978-000x	Console/ Keyboard Interface	F1 F2	G50382-0021	MSF 034.4224	273002	2 A 125 V Plug-In

Console CRTs

The color CRT monitors that can be used with the Multitube Command Console include:

- 17-inch IIYAMA Vision Master CRT
- 21-inch Hitachi HM–4721–D CRT
- 17-inch ViewSonic 17GS CRT
- 15-inch Mag Innovision CRT
- 14-inch Sony CRT
- 19-inch Conrac 7241 CRT (Conrac 7122 in 220 volt version)
- 20-inch Barco CD 551 and ICD 551 CRT

ROS CRT: IIYAMA Vision Master

The IIYAMA Vision Master CRT (55P0144x022) is a 17-inch color unit.

The unit runs on either 115 or 220 VAC, 50 or 60 Hz (108–132 / 198–264 VAC auto selecting).

Setup and controls are described in the user manual that accompanies the unit.

Multitube Command Console CRT: Hitachi HM–4721–D

The Hitachi HM–4721–D CRT (12P0373x032) is a 21-inch color unit that connects to the Keyboard Interface. This CRT requires video isolation provided by the keyboard interface card.

The unit runs on either 115 or 220 VAC (100–120 / 200–240 VAC auto selecting). Setup and controls are described in the user manual that accompanies the unit.

Multitube Command Console CRT: ViewSonic 17GS

The ViewSonic 17GS CRT (10P56120001) is a 17-inch color unit that connects to the Keyboard Interface via a D-Sub connector and twisted pairs of wires. This CRT requires video isolation provided by the keyboard interface card.

The unit runs on either 115 or 220 VAC (100–240 VAC auto selecting). Setup and controls are described in the user manual that accompanies the unit.

Multitube Command Console CRT: Mag Innovision

The Mag Innovision CRT (10P50660002) is a 15-inch color unit that connects to the Keyboard Interface via a D-Sub connector and twisted pairs of wires. This CRT requires video isolation provided by the keyboard interface card. This unit can replace any 14-inch Sony unit. The adapter cable is part of the assembly.

The unit runs on either 115 or 220 VAC. Setup and controls are described in the user manual that accompanies the unit.

If the unit goes out of adjustment, first try the Brightness and Contrast dials at the front. If this fails, you can restore the default settings by:

1. Open the hinged door in front. Check that the User-Preset switch is set to Preset.
2. Press the Recall/Program button.

Multitube Command Console CRT: Sony

The Sony CRT (1984-3286-000x, 1984-3246-000x, or 1984-2633-000x) is a 14-inch color unit that connects to the Keyboard Interface via a D-Sub connector and twisted pairs of wires. This CRT requires video isolation provided by the keyboard interface card.

These models have been used. Each requires the use of an adapter cable, as shown in Table 3.1.16. All are interchangeable.

Table 3.1.16. Adaptor Cables for Sony CRTs

Part No.	Model No.	Adaptor Cable
1984-3286-000x	CPD-1430	1984-3287-9500
1984-3246-000x	CPD-1304S C-1404S	1984-3245-0001
1984-2633-000x	CPD-1304	1984-3005-9030

Figure 3.1.12 shows typical wiring for the Sony CRT.

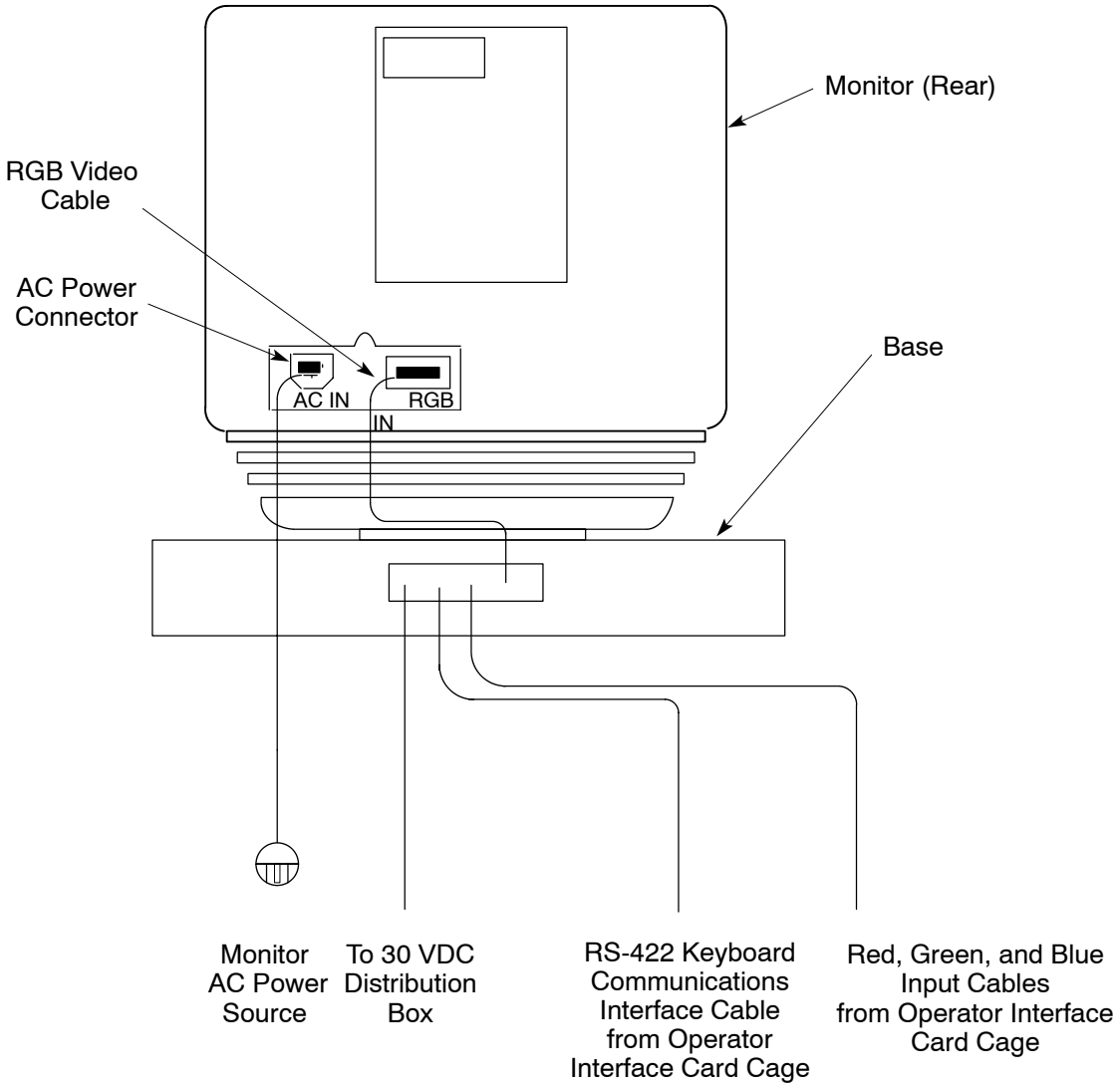

Monitor (Rear)
RGB Video Cable
AC Power Connector
Base
AC IN
RGB IN
Monitor AC Power Source
To 30 VDC Distribution Box
RS-422 Keyboard Communications Interface Cable from Operator Interface Card Cage
Red, Green, and Blue Input Cables from Operator Interface Card Cage

Figure 3.1.12. Cable Routing for 14-Inch Sony Monitor

The adjustments available on the side of the Sony CRT are shown in Figure 3.1.13 and in Table 3.1.17.

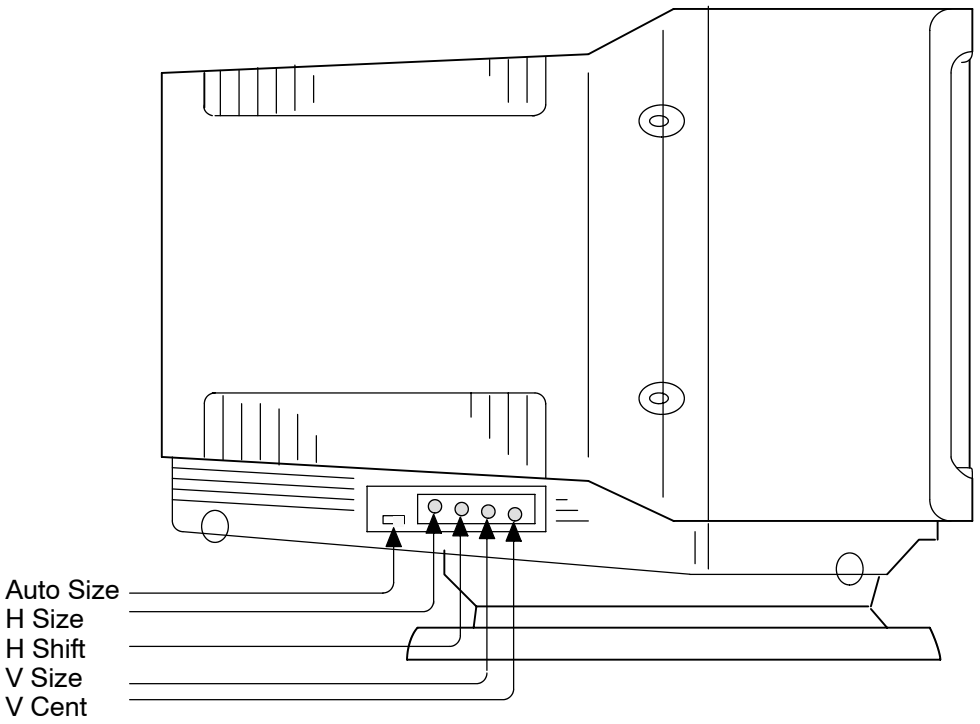


Figure 3.1.13. 14-Inch Sony Monitor Adjustments

Table 3.1.17. Sony Monitor Adjustments

Control	Function
AUTO SIZE	Must be set to “ADJ” to enable use of the other controls.
H Size (horizontal size)	Used to adjust the horizontal size of the display.
H Shift (horizontal shift)	Used to adjust the center of the display horizontally.
V Size (vertical size)	Used to adjust the vertical size of the display.
V Cent (vertical center)	Used to adjust the center of the display vertically.

Multitube Command Console CRT: Conrac 7122 and 7241

The model 7241 and 7122 19-inch color CRT (1984–1651–0027) is manufactured by Conrac Inc. 220 volt applications use model 7122. Figure 3.1.14 shows a block diagram of the CRT circuitry. See the Conrac 7241 User Guide (1984–1651–0013) and the Conrac 7241 Installation and Operation Manual (1984–1651–0006) for detailed information.

The Conrac monitor has internal video isolation so that you can cable it directly from the OI Card Cage. The 7241 monitor uses RGB video signals with the Vertical and Horizontal sync superimposed on the Green video signal. The Video Processor removes the sync signals from the Green signal and passes them to the Scan Board. The Scan Board generates the Vertical and Horizontal drive signals to the CRT yokes. The High Voltage Module is monitored and controlled from the Scan Board. Control of High Voltage Shutdown is on the Scan Board. All the power that is needed by the complete CRT is developed and controlled by the Power Transformer and the Low Voltage Regulator Board. A separate 120 VAC input is required for the Conrac Monitor.

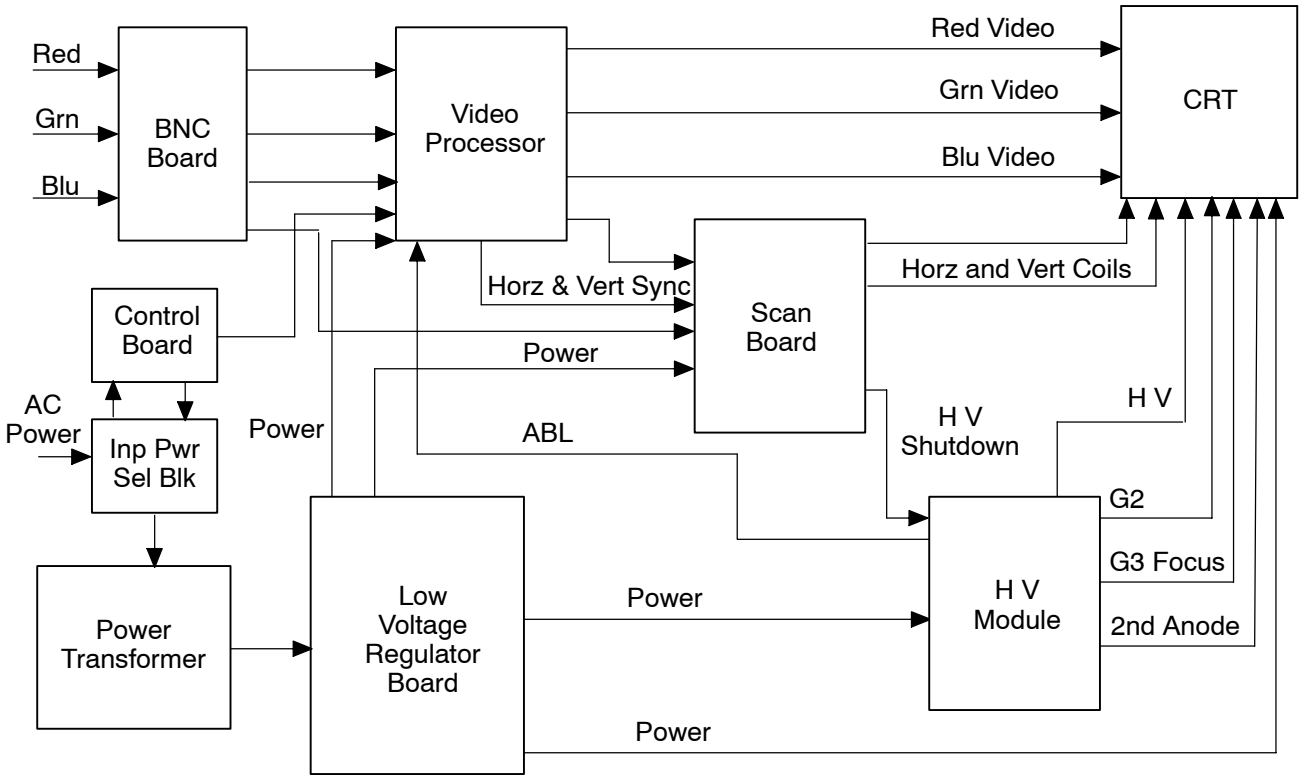


Figure 3.1.14. Conrac 7241 CRT Block Diagram

Figure 3.1.15 shows the switches and connections at the rear of the monitor. Switch settings S1, S2, and S3 set up the input impedance for the RGB coaxial input. S4 and S5 are set up to use internal Vertical and Horizontal sync. S6 selects the raster size and S7 Lo, Hi or Med frequency.

NOTE: This assumes use of Pixel Graphics.

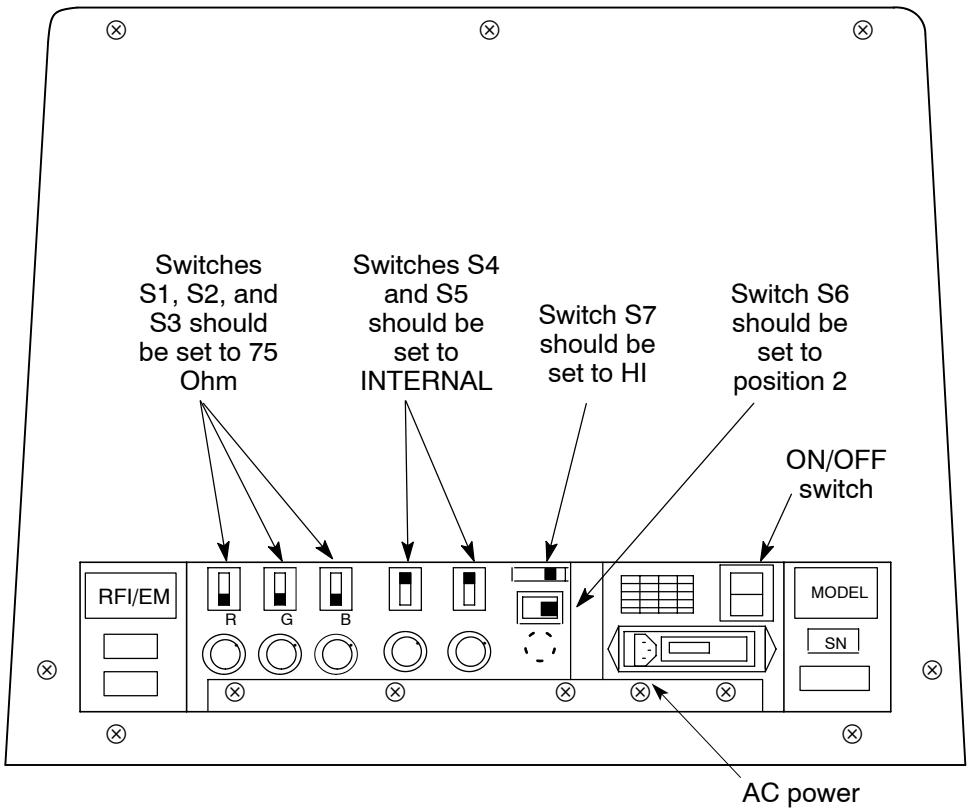


Figure 3.1.15. Conrac 7241 CRT (Back View)

Table 3.1.18 lists the FRSI part number for Conrac 7241 components.

Table 3.1.18. Conrac 7241 Components

Component	FRSI Part Number	Conrac Part Number
Scan Board (Selectable)	1984-1651-0018	162885-77
BNC (Selectable)	1984-1651-0033	162938-74A
Video Processor Board	1984-1651-0004	162838-72
High Voltage Module	1166-0524-0010	106513-6
Low Voltage Regulator Board	1984-1651-0007	162931-71
CRT Socket Board	1984-1651-0019	162921-72
Control Board	1984-1651-0020	162951-71

Conrac 7241 CRT Scan Board Failures

In certain cases, a failure of the Scan board (1984-1651-0018) also causes a failure of the Low Voltage Regulator board (1984-1651-0007).

NOTE: If you suspect that the Scan board is bad, always check the Low Voltage Regulator board before you replace the Scan board. Failure to do this can result in damage to the new Scan board.

Table 3.1.19 shows the nominal voltages on the Low Voltage Regulator board. If any voltages are missing or are far from nominal, replace the Low Voltage Regulator board before you replace the Scan board. Also check for AC ripple.

Table 3.1.19. Conrac 7241 Low Voltage Regulator Test Points

Test Point	Nominal Voltage	Range
01	Ground	
2	6.3 VDC	5.3-6.6
4	14.0 VDC	138-142
5	84 VDC	82.3-88.2
7	35 VDC	34.95-35.05
9	24 VDC	23.9-24.1

Conrac 7241 CRT Scan Board Adjustments

Horizontal or vertical adjustments require the use of different pots on the Scan board (1984–1651–0018). Table 3.1.20 lists the adjustments on the Scan board and Figure 3.1.16 shows the pot location.

Table 3.1.20. Conrac 7241 Scan Board Adjustments

Adjustment	Label
Vertical Hold	R195
Vertical Center	R29
Vertical Height	R190
Vertical Linearity	R11
Horizontal Hold (Pixel Board)	R168
Horizontal Hold (Character Board)	R154
Horizontal Center	R83
Horizontal Width (Pixel Board)	R171
Horizontal Width (Character Board)	R157
Side Pincushion	R132
Static Phase	R188

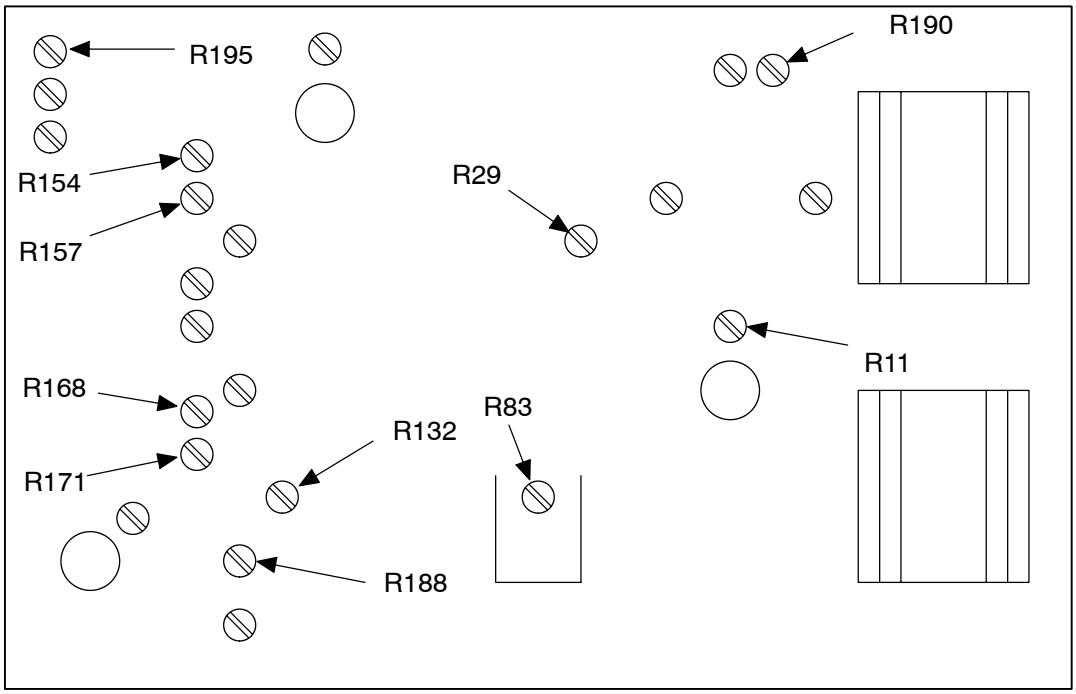


Figure 3.1.16. Conrac 7241 Scan Board Adjustment Locations

Conrac 7241 CRT Black Video or Black Bars on Screen

If there are black bars across the screen or the top half of the screen is green and the bottom is black, adjust the synch gain pot.

The synch gain pot (R301) is on the Video Processor board (1984–1651–0004). Turn the pot to a higher gain (clockwise) until the screen returns to normal. If this does not work, replace the Video Processor board.

Conrac 7241 CRT Power-up Diagnostics Failures

Failure of the Video Generator Color Test or the Synch Test during boot-up of a pixel graphics console is often due to a floating DC bus. It can also be caused by the switches on the BNC card not being set to 75 ohms.

Prior to March 1988, remotely powered devices (such as MTCC, CC, and OI Electronics) were shipped without a ground wire to the DC RTN terminal of the AC/DC Remote Power Supply (1984–1046–000x).

Install 12 gauge green insulated wire between the DC RTN lug of the power supply and the designated chassis ground connection on all remotely powered devices.

Multitube Command Console CRT: Barco CD 551 and ICD 551

The Barco CD 551 CRT (1984-3065-000x) is a 20-inch color unit that connects to the Keyboard Interface via the RGB coaxial cables (1984-1691-0003). This CRT requires the video isolation provided by the 1984-2889-000x Keyboard Interface.

Kits are available to allow replacement of a CONRAC monitor with a Barco monitor.

Barco technical documentation is available:

- CD 551 User Manual 1984-3065-0032
- CD 551 Service Manual 1984-3065-0034

Figure 3.1.17 shows the block diagram of the Barco CD 551 or 651 CRT.

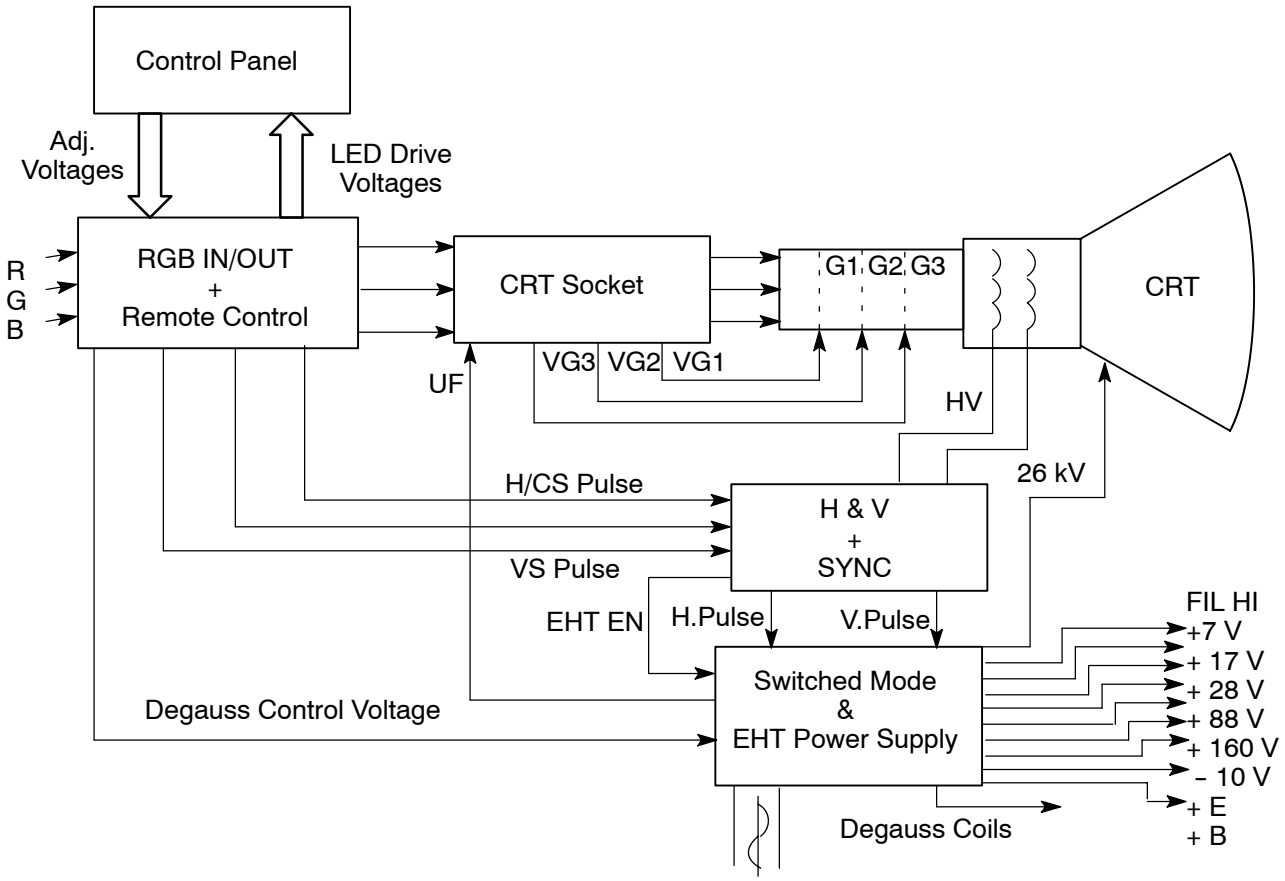


Figure 3.1.17. Barco CD 551 CRT Block Diagram

Figure 3.1.18 and Figure 3.1.19 show the rear view of the monitor with switches and connections for the input cables. SYNC must be set to INTERNAL.

The three switches on the R, G, and B panels select the input impedance for the RGB coaxial cable (1984–1691–0003). These must be set to 75 ohms.

NOTE: If two or three monitors are daisy chained on the line, the switches of the last monitor on the line must be set to 75 ohms. The others must be set to a high impedance.

Connect the cables to the right-hand set of coaxial connectors on the input panel. The left-hand set of connectors can be used to daisy chain additional monitors.

Brightness and contrast adjustments are also on the input panel.

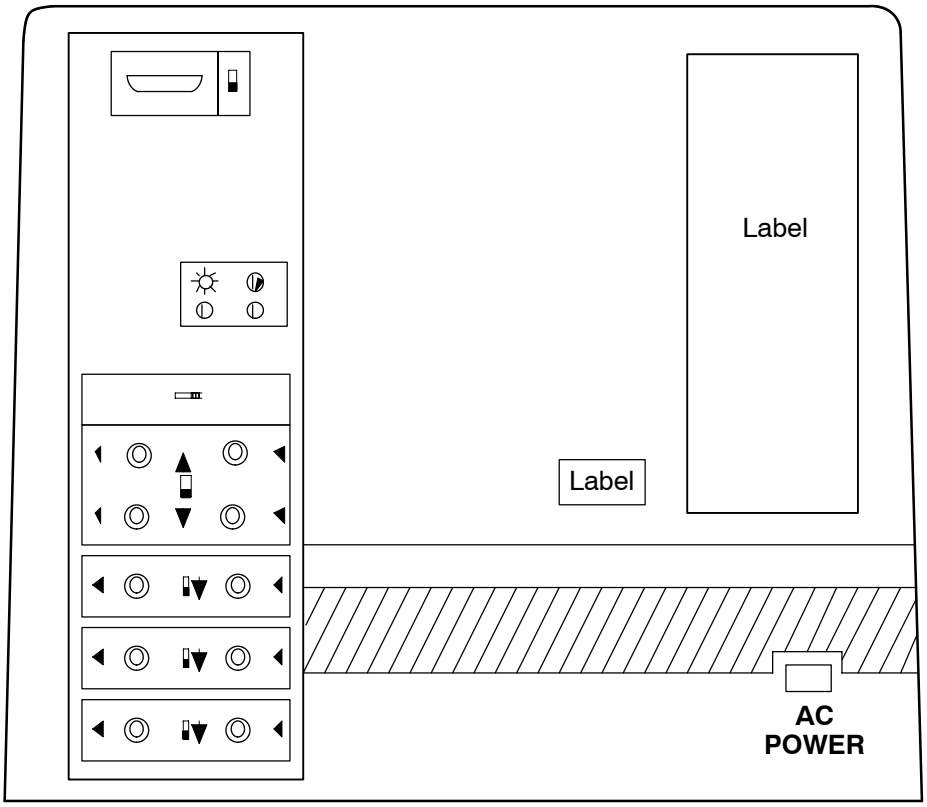


Figure 3.1.18. Barco CD 551 CRT (Back View)

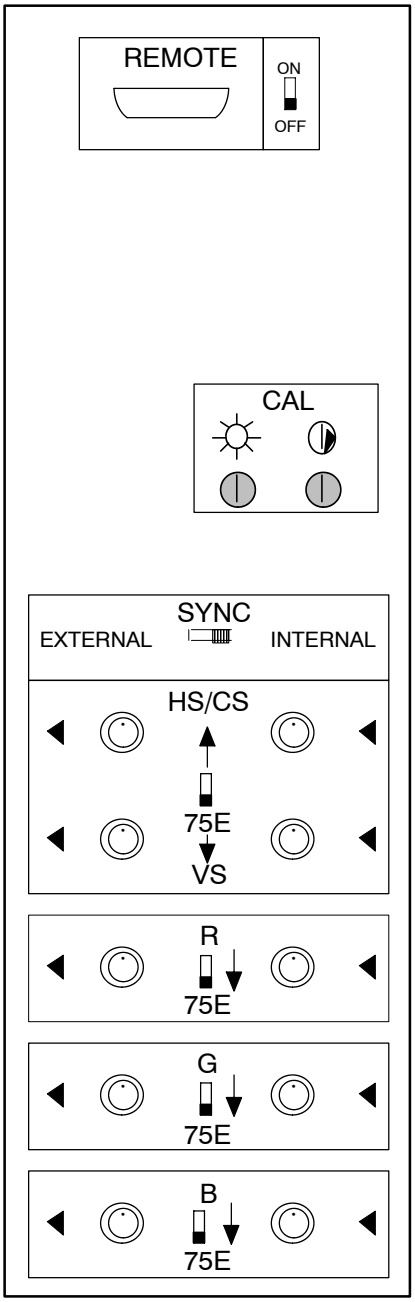


Figure 3.1.19. Barco CD 551 CRT (Input Panel)

Figure 3.1.20 shows the Deflection board. Adjustments on this board include:

- horizontal
- vertical
- blanking
- skew
- clamping
- scan selection

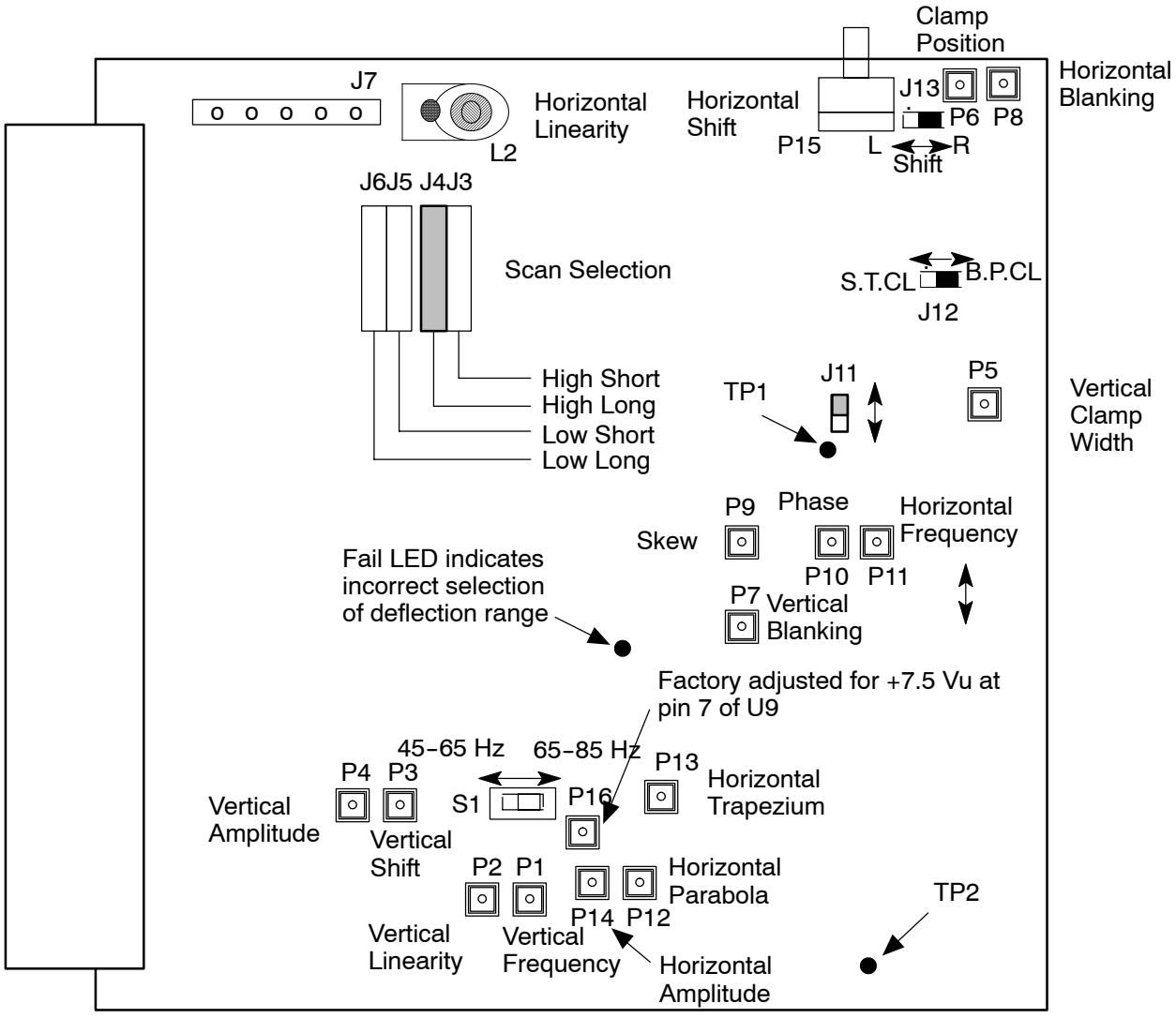


Figure 3.1.20. Barco CD 551 CRT Deflection Board

Figure 3.1.21 shows the Input/Output Amplifier and Remote Control board.

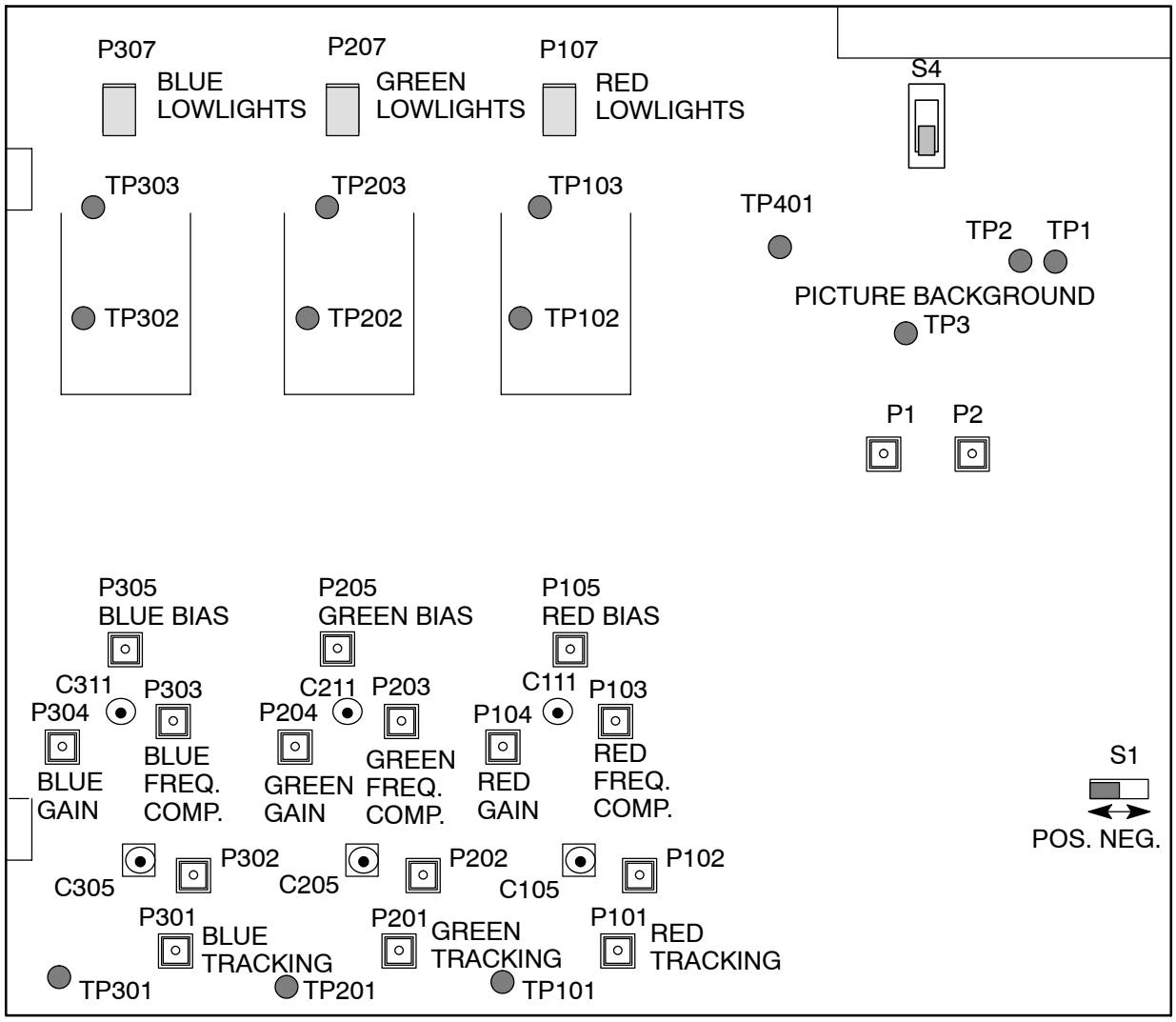


Figure 3.1.21. Barco CRT RGB Input/Output Amplifier and Remote Control

Figure 3.1.22 shows the power supply board.

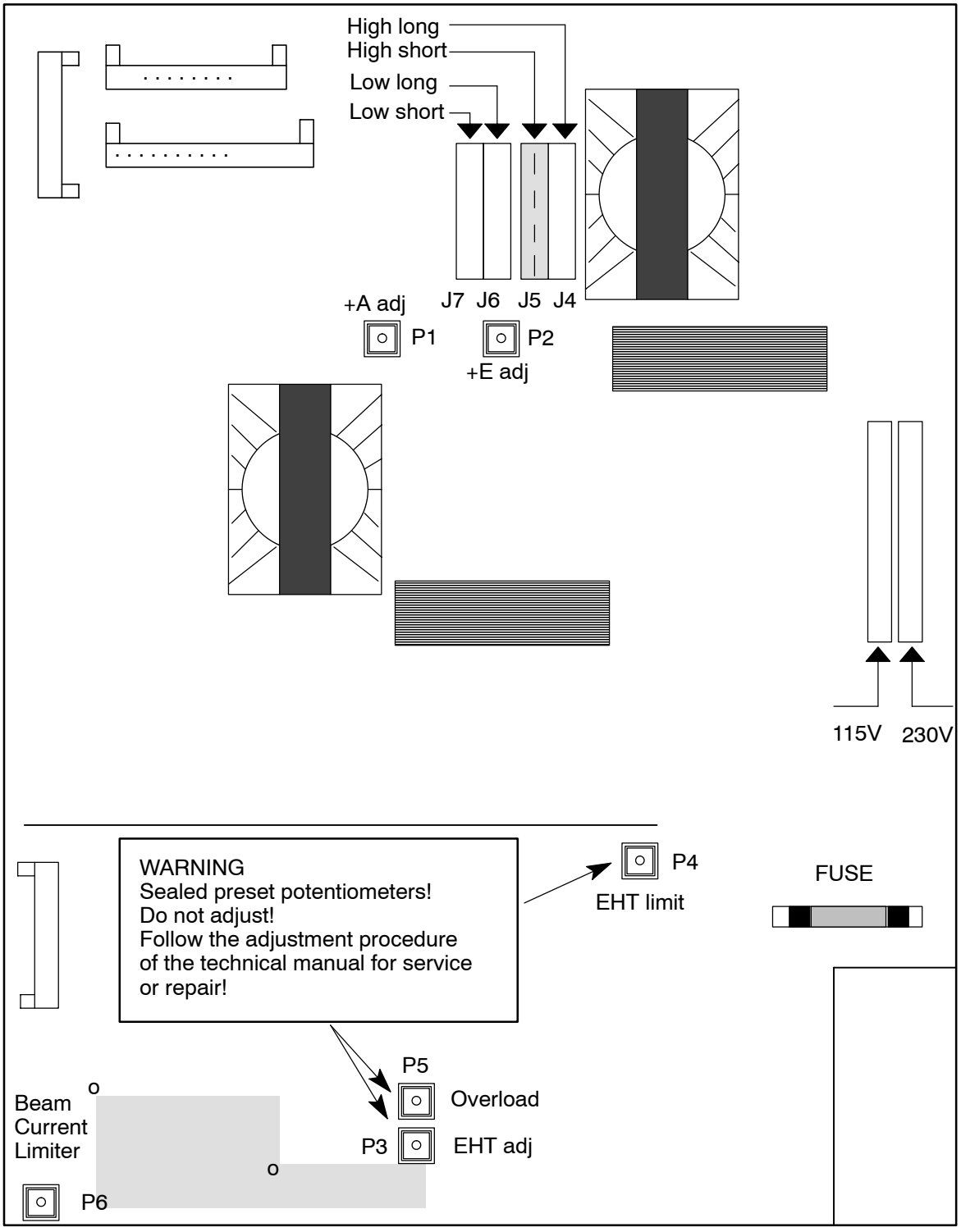


Figure 3.1.22. Barco CRT Switched Mode and EHT Power Supply

Section 2:
Pedestal Command Console and Basic Command Console

This section covers the free standing operator interface portion of the Pedestal Command Console, and the Basic Command Console.

The console card cage and electronics are covered in Section 6 of this chapter. Peripheral devices (disk, tape, and printer) are covered in Sections 4 and 5 of this chapter. Maintenance and troubleshooting of the console are covered in chapters 9 and 10.

Figure 3.2.1 shows front and side views of the Pedestal Command Console. Figure 3.2.2 shows the back of the console with access covers removed.

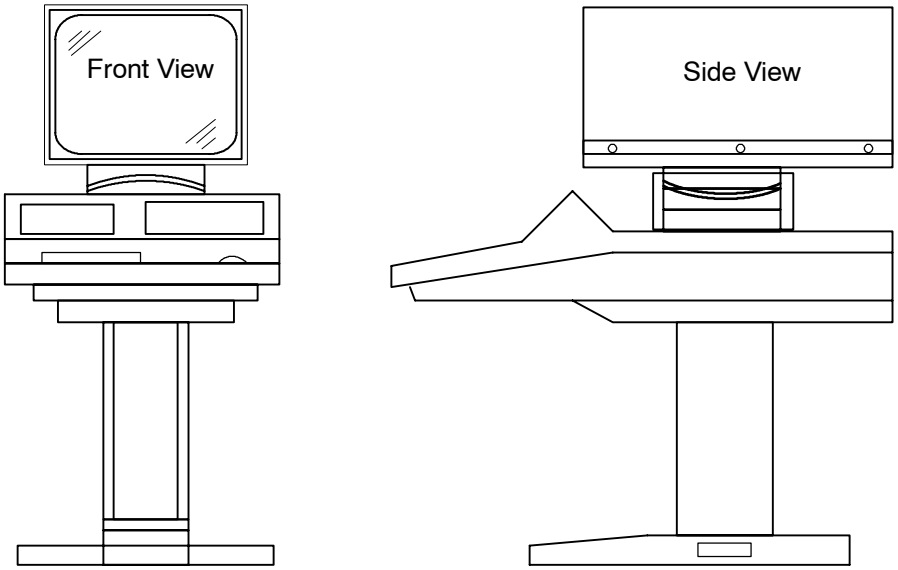


Figure 3.2.1. Pedestal Command Console

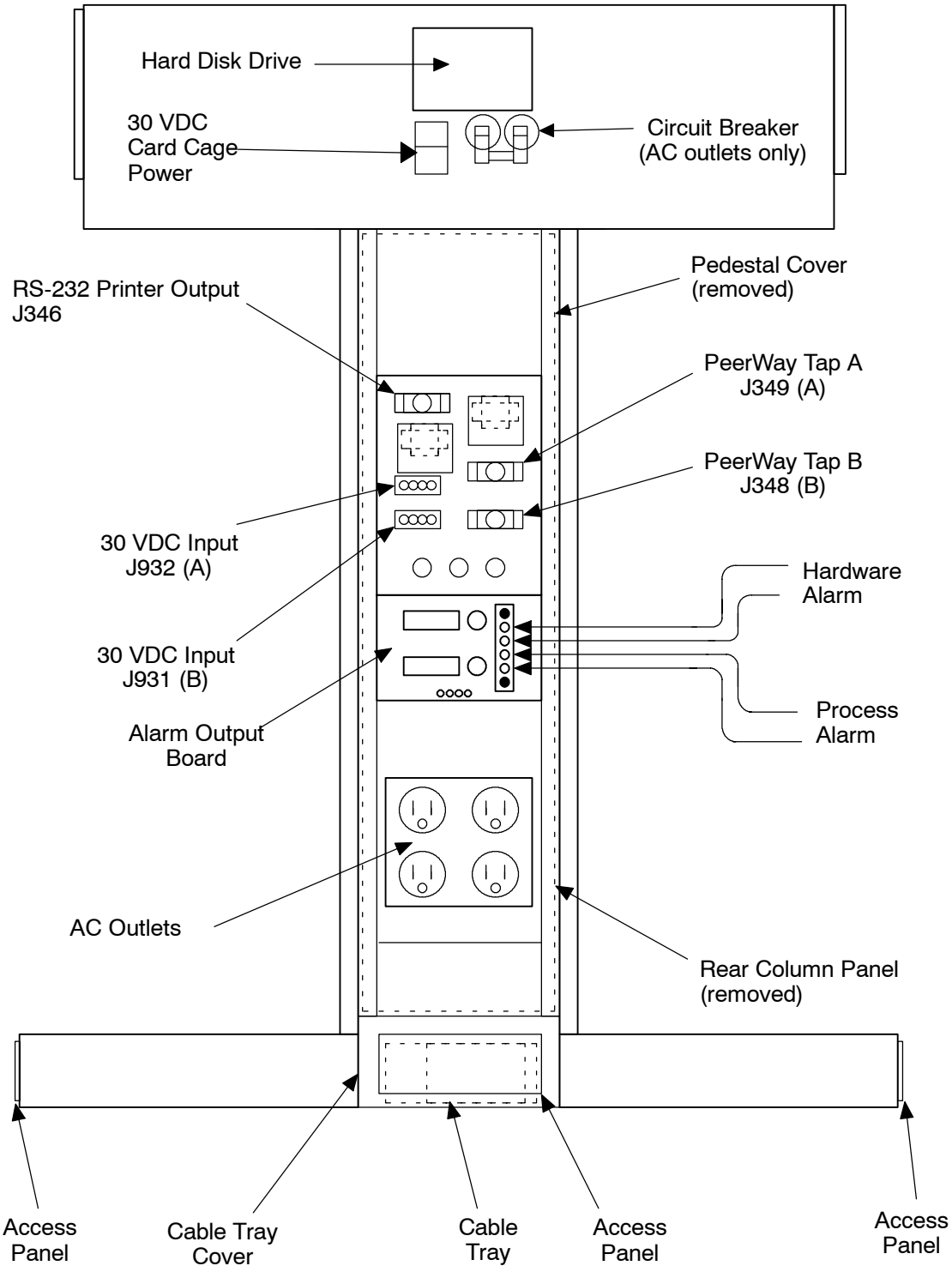


Figure 3.2.2. Pedestal Command Console (Rear View)

Pedestal Command Console Keyboards

The Pedestal Command Console keyboards are arranged as shown in Figure 3.2.3

They are:

- Loop Callup Keyboard
- Command Entry Keyboard
- Configuration Keyboard
- Trackball Keyboard
- Rotating (Alphanumeric) Keyboard
- Keyswitch Assembly

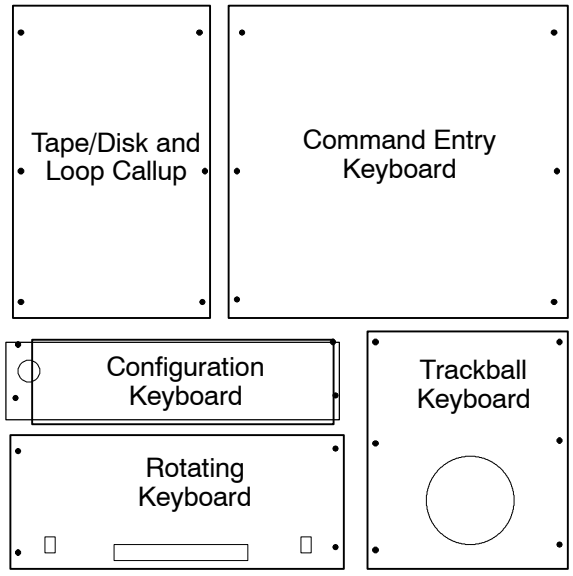


Figure 3.2.3. Pedestal Command Console Keyboard Layout

Pedestal Command Console Loop Callup Keyboard

The Command Console Loop Callup Keyboard (1984–1915–000x) is marked “LOOP CALLUP (32 SWITCHES)” on the printed wiring assembly (PWA).

There are no field replaceable parts.

Pedestal Command Console Command Entry Keyboard

The Command Console Command Entry Keyboard (1984–1731–000x or 1984–1934–000x) is marked “COMMAND ENTRY SWITCH MATRIX” on the PWA.

There are no field replaceable parts.

Pedestal Command Console Configuration Keyboard

The Command Console Configuration Keyboard (1984–1776–000x) is marked “BLOCK CONFIGURATOR SWITCH MATRIX” on the PWA.

There are no field replaceable parts.

Pedestal Command Console Trackball Keyboard

The Command Console Trackball Keyboard (1984–1779–000x) is marked “TRACKBALL SW MATRIX” on the PWA.

There are no field replaceable parts.

Pedestal Command Console Rotating (Alphanumeric) Keyboard

The Command Console Rotating (Alphanumeric) Keyboard (1984-1825-000x) is a single assembly, which includes the keyboard and brackets.

There are no field replaceable parts.

Pedestal Command Console Keyswitch Assembly

The Command Console Keyswitch Assembly (1984-0657-000x) is a single assembly which includes the cable.

There are no field replaceable parts.

Pedestal Command Console Keyboard Interface

The Keyboard Interface (1984-1782-000x and 1984-1921-000x) is used in the Basic Command Console and the Pedestal Command Console to connect the keyboards with the console electronics.

1984-1782-000x is marked “OI KEYBOARD INTERFACE” on the PWA.

1984-1921-000x is marked “OS KEYBOARD INTERFACE” on the PWA.

The Keyboard Interface is used to combine signals from all of the keyboard assemblies into one cable to the OI Processor Board. All communications to the OI Processor Board are in the RS-422 format.

The console will report bad keys (shorted or excessive length keystroke) by the message “Keyboard Error X:YY” where X represents the keyboard number (always 1 on Pedestal Command Consoles) and YY represents the key. The alphanumeric keyboard is not reported. Table 3.2.1 shows the map of key numbers to keyboard.

Table 3.2.1. Command Console Key Map

Key Number	Keyboard	Part Number
1-26 32-63	Command Console Entry Keyboard	1984-1731-000x
64-68	Trackball and Cursor Control	1984-1779-000x
72-87	Block Configuration	1984-1776-000x
27-31 69-71	Not Used	--

NOTE: It is extremely important to verify proper connector orientation before applying power to the Command Console. Failure to do so may result in permanent damage to the Keyboard Interface circuitry.

Be sure to line up the colored stripe on the ribbon cable with the embossed triangle on the Keyboard Interface connector.

Figure 3.2.4 shows the 1984-1921-000x Keyboard Interface and connections.

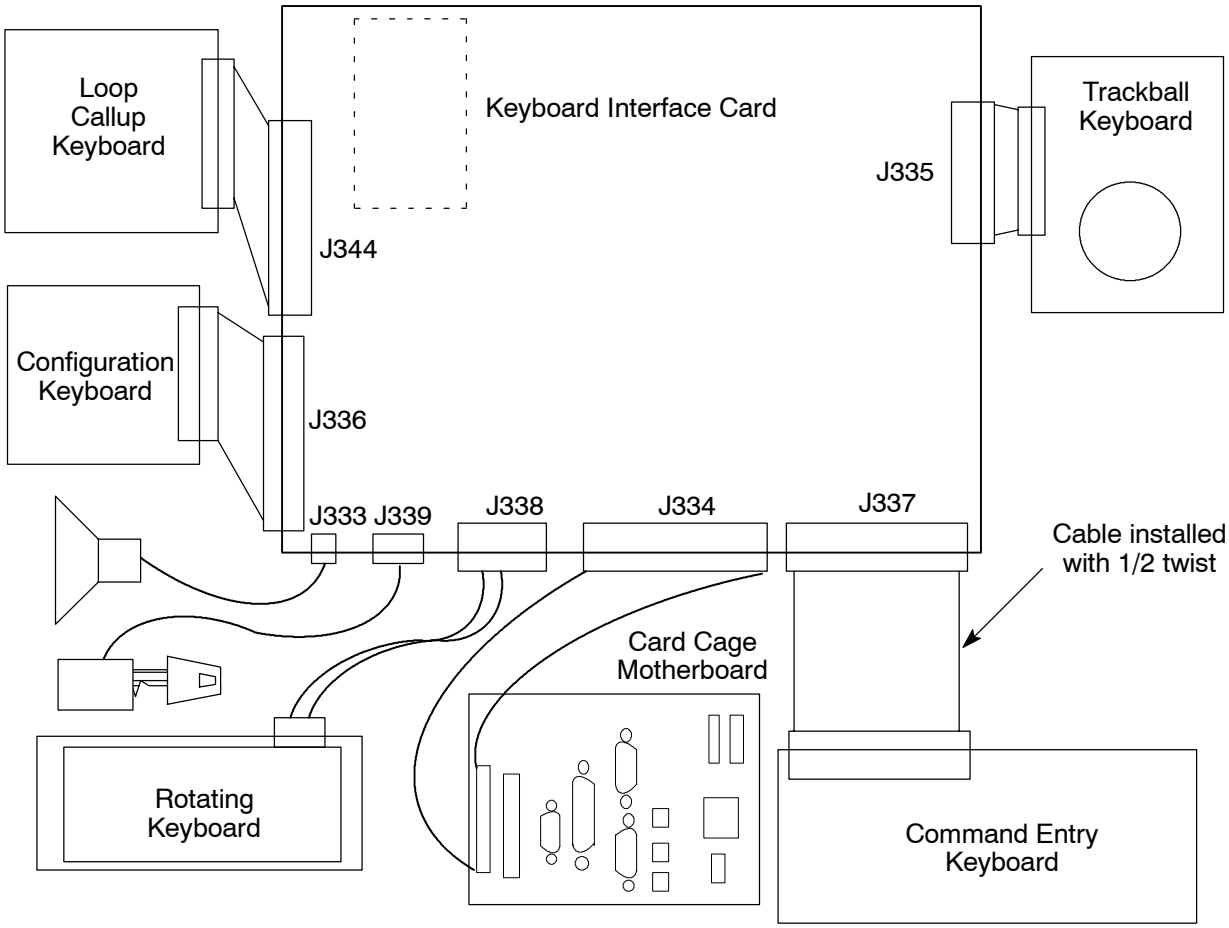


Figure 3.2.4. Basic and Pedestal Command Console Keyboard Interface (1984-1921-000x)

Table 3.2.2 gives parts replacement data.

Table 3.2.2. Keyboard Interface Parts Replacement

Part No.	Part Name on PWA	Replaces
1984-1921-000x	OS KEYBOARD INTERFACE	1984-1782-000x
1984-1782-000x	OI KEYBOARD INTERFACE	

Pedestal Command Console CRT

The model 7211 19-Inch color CRT (1984-1872-000x) is a character based CRT manufactured by Conrac, Inc. It is used on both the Pedestal Command and the Basic Command Consoles. Figure 3.2.5 shows a block diagram of the CRT circuitry. See Section 7 of the Conrac 7211 maintenance manual (7900-0317-0023) for a complete diagram.

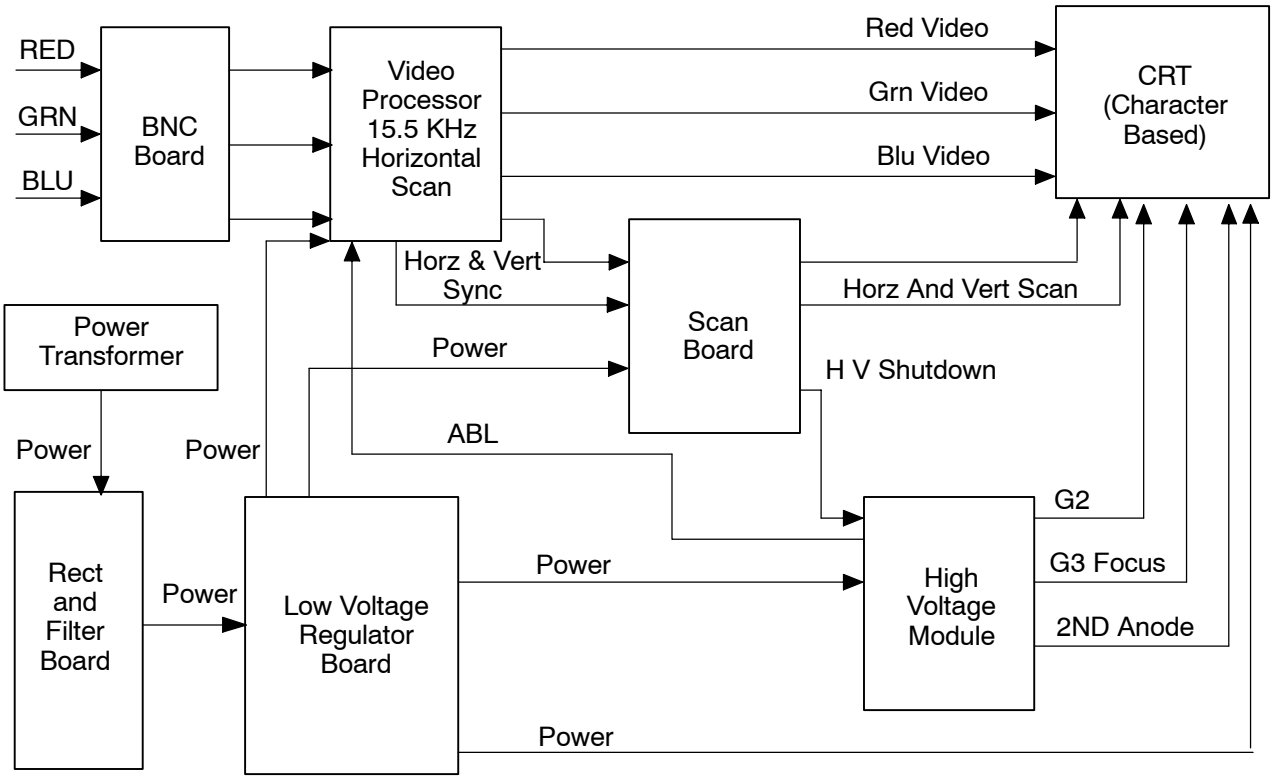


Figure 3.2.5. Conrac 7211 CRT Block Diagram

The 7211 monitor uses RGB video signals. The Vertical and Horizontal sync are superimposed on the Green video signal. The Video Processor removes the sync signals from the Green signal and passes them to the Scan Board. The Video Processor conditions the color video and passes them to the CRT Guns. The Scan Board generates the Vert and Horz drive signals to the CRT yokes. Control of High Voltage Shutdown is on the Scan Board. The High Voltage Module is monitored and controlled from the Scan Board. All the power that is needed by the complete CRT is developed and controlled by the Rectifier/Filter Board, and the Low Voltage Regulator Board. A separate 120 VAC input is required for the Conrac 7211 Monitor.

Figure 3.2.6 shows the connections to the CRT. Terminator switches must be in the 75-ohm position.

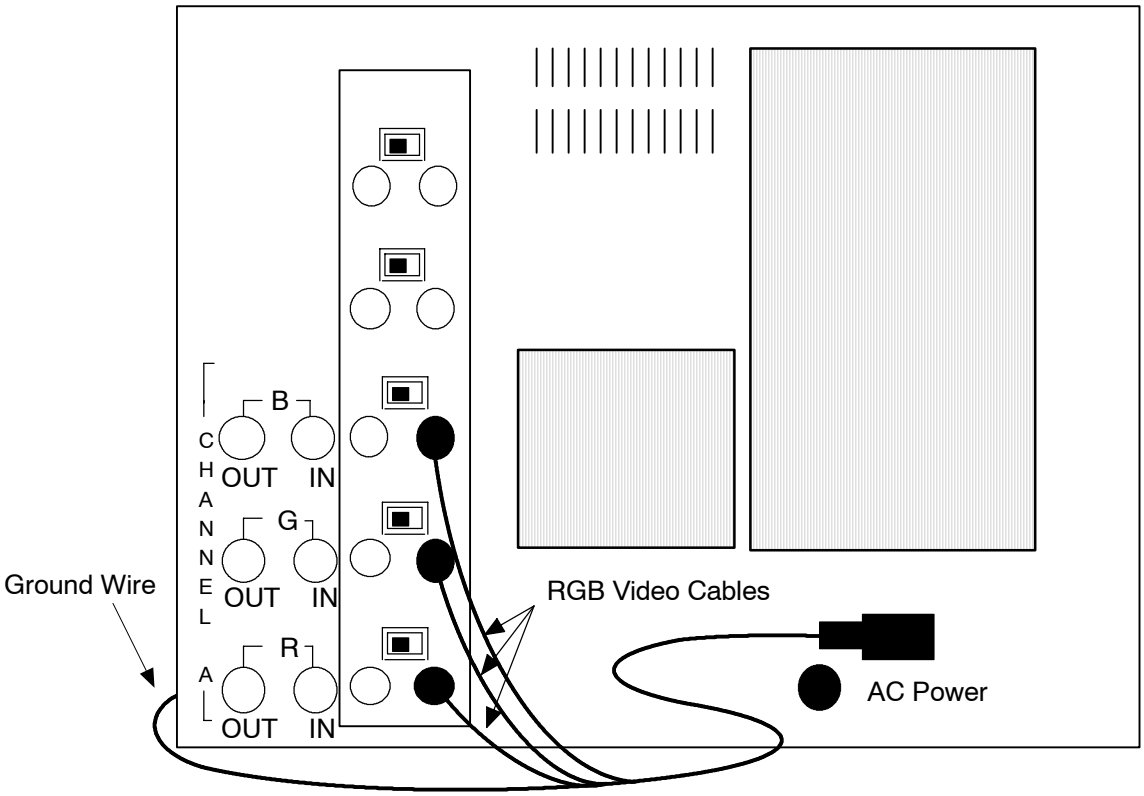


Figure 3.2.6. Conrac 7211 CRT (Back View)

Table 3.2.3 lists the FRSI part numbers for components of the Conrac 7211 CRT.

Table 3.2.3. Conrac 7211 CRT Components

Component	FRSI Part Number	Comment
Scan Board (15.75 kHz)	1166-0524-0016	
BNC (Differential)	1166-0524-0044	
Video Processor Board (Differential)	1166-0524-0045	
BNC (Single Ended)	1166-0524-0011	Replaced by 1166-0524-0044
Video Processor Board (Single Ended)	1166-0524-0012	Replaced by 1166-0524-0045
High Voltage Module	1166-0524-0010	
Low Voltage Regulator Board	1166-0524-0015	
CRT Socket Board	1166-0524-0013	
Rectifier and Filter Board	1166-0524-0014	
Control Board	1166-0524-0017	

Pedestal Command Console Disk Interface Card (SCSI)

The Pedestal Command Console uses the same Disk Interface card (1984–1140–000x) as the Multitube Console. See the discussion in this chapter, Section 6 (OI Card Cage) for details.

Remote Command Console Power Supply

The Remote Command Console Power Supply (1984–1046–000x) is described in Chapter 1, Section 2 (Power Supplies).

Pedestal Command Console Printer Interface Card

The Pedestal Command Console uses the same Printer Interface card (1984–1011–000x) as the Multitube Console. See the discussion in this chapter, Section 6 (OI Card Cage) for details.

Section 3:
MiniConsole

This section covers the operator interface and electronics of the MiniConsole. Many cards of the MiniConsole are identical to those used in the Pedestal Command Console and Multitube Command Console. These will be described in Section 6 of this chapter “OI Card Cage”.

This section covers the MiniConsole:

- Block Diagram
- Keyboards
- Power Regulator card (see Section 6)
- PeerWay Interface card (see Section 6)
- OI Processor card 68000 (see Section 6)
- Monochrome Video Generator card
- Monochrome CRT
- SCSI card (see Section 6)
- Floppy Interface (I/F) Connect card
- 5.25-Inch Floppy Disk Drive (Section 4, Disk and Tape Drives)
- Floppy Disk Power Supply (Section 4, Disk and Tape Drives)
- Remote Power Supply (see Chapter 1, Section 2, Power Supplies)

Maintenance and troubleshooting are covered in chapters 9 and 10.

Figure 3.3.1 shows front and rear views of the MiniConsole.
Figure 3.3.2 gives a block diagram of the MiniConsole.

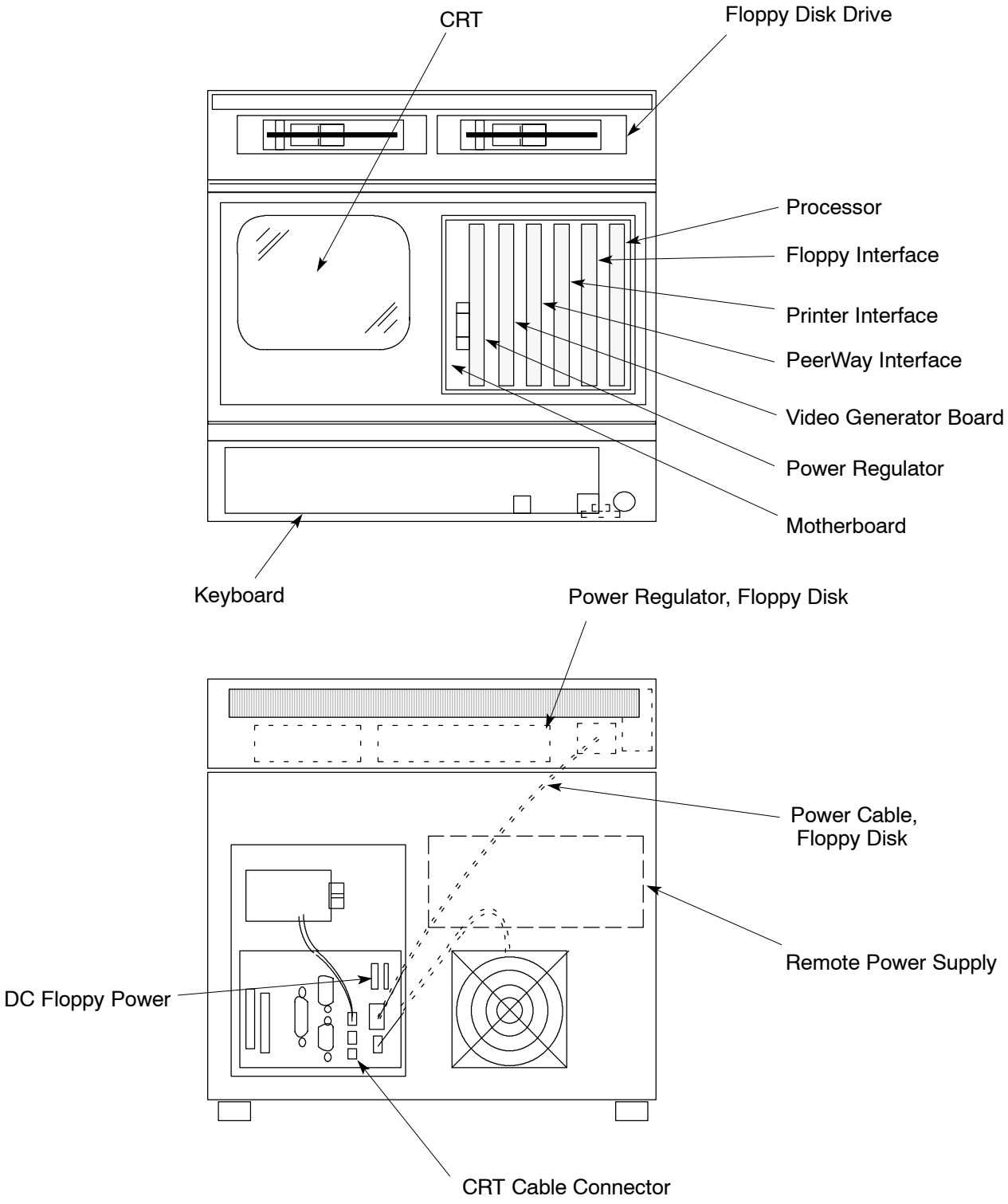


Figure 3.3.1. MiniConsole

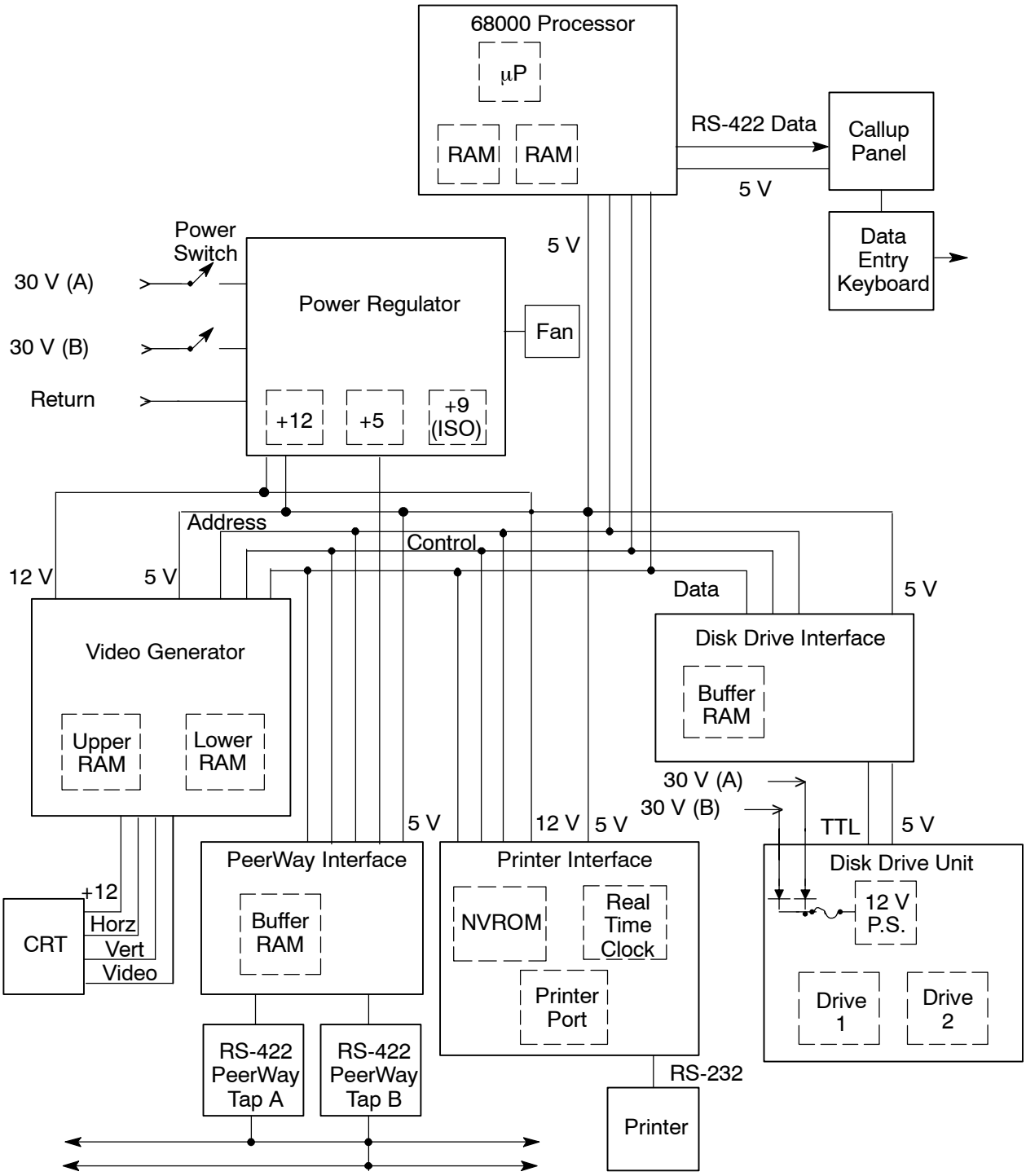


Figure 3.3.2. MiniConsole Block Diagram

MiniConsole Keyboards

The MiniConsole keyboards provide operator interface with the console through the alphanumeric keyboard, loop control, loop callup keyboard, loop alarm LEDs, speaker, and keyboard switch. Figure 3.3.3 shows a functional diagram for a MiniConsole keyboard.

All connections to the keyboard are made through a single cable from the console motherboard and driven by RS-422 signals from the processor. The loop control buttons are in a configuration similar to the Analog Panel Stations and are used to control the loop displayed on the CRT.

The loop callup buttons are used to address any one loop in the system for display on the CRT. Each is configurable through the main operator keyboard. The Keyboard switch is used to limit configuration access in the system. An audio alarm generator is used to indicate alarm status in the system and has variable frequency and volume. The main keyboard has the standard alphanumeric keyboard and some special keyboards for screen control.

All control of the front panel is handled by the Console Processor card via an extension of the bus through the cable. Bus buffers isolate the card from the rest of the system. The 12 loop control and 32 loop callup buttons are sensed by driving each of the 8 strobe lines low one at a time. The sense lines are pulled up to +5 V through pullup resistors. The strobe and sense lines form a matrix with a momentary contact switch at each intersection point. As a button is pushed, the sense line is pulled low. The microprocessor senses the line pulled low and knows which strobe line is activated at that point. Each intersection point is a different key.

Each loop has a process alarm LED associated with it and is driven by a latch off the bus. There are 32 LEDs driven by these latches.

The alphanumeric keyboard has its own microprocessor that handles all keyboard strobing and sensing. It outputs the ASCII character code for the key to the front panel circuitry, through a buffer, to the console bus. This keyboard is designed so that if any key fails closed, it will not cause all the keys to lock up. The microcomputer in the keyboard sends a periodic null character to indicate that it is still operating. If the console processor does not receive this character every 100 microseconds, it will send a reset command to the keyboard.

The speaker has a 555 timer that provides an oscillator frequency. This output is divided through a programmable counter whose output frequency is controlled by the console bus, whose amplitude is controlled through several Field Effect Transistors (FETs).

The keyswitch is sensed through 5 buffer lines for a Binary-Coded Decimal (BCD) weighted input to the processor. There are 32 different keys that can be used with the switch.

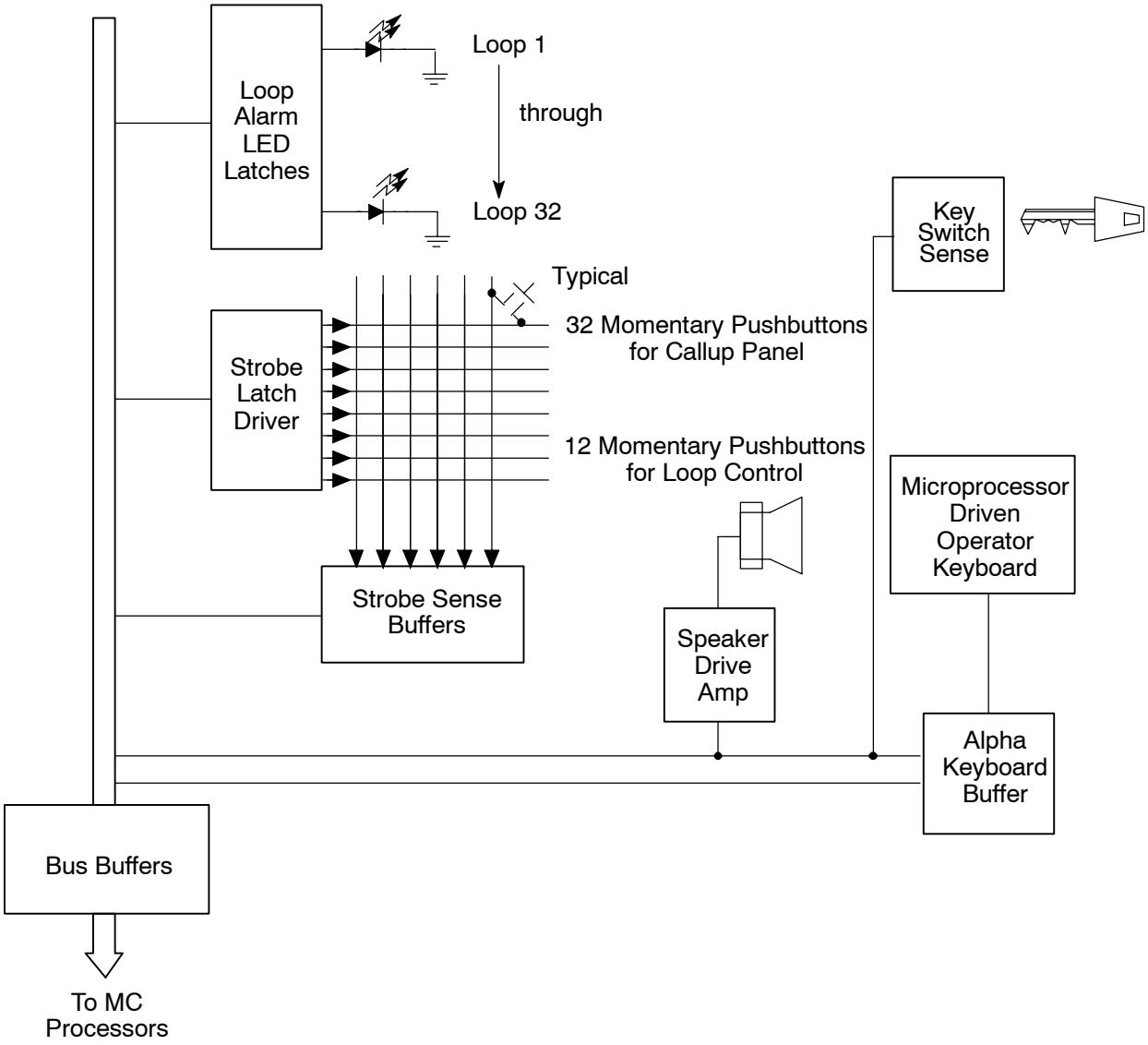


Figure 3.3.3. MiniConsole Front Panel Keyboard Functional Diagram

MiniConsole Power Regulator Card

The Power Regulator card (1984-1137-000x or 1984-1017-000x) is described in Section 5 of this Chapter.

MiniConsole PeerWay Interface Card

The PeerWay Interface card (1984-1045-000x) is described in Section 5 of this Chapter.

MiniConsole OI Processor Card

The OI (Operator Interface) Processor card (1984-2137-000x, 1984-2122-000x, 1984-2120-000x, 1984-2107-000x, or 1984-1061-000x) is described in Section 5 of this Chapter.

Monochrome Video Generator

The Monochrome Video Generator (1984-1002-000x) is used in the MiniConsole to generate the signals necessary to drive the 9-inch monochrome CRT. It is marked “MC VIDEO GENERATOR” on the printed wiring assembly (PWA). Figure 3.3.4 shows the functional diagram of a Monochrome Video Generator.

The Video Generator can drive the CRT at varying brightness levels. The remote intensity can be controlled character by character or on a whole screen basis. This is done by data attributes stored along with each character and converted from digital to an analog bias in the video drive. The drives to the CRT are transistor to transistor logic (TTL) signals for the horizontal and vertical synch and analog signals for the video.

The monochrome CRT screen is 80 characters wide and 24 lines high. There is a possible total of 1920 character spaces on one screen. The ASCII character designation and the attributes are stored in one of two memories on the Video Generator card. The CRT Controller reads data for two consecutive characters from the upper memory while the processor is writing data to the lower memory. Each character occupies two addresses in RAM memory. The first address contains the attributes for the character. Character attributes include normal or inverted video, blink, underline, and gray scale (brightness).

A full screen update takes place 30 times a second.

The CRT controller handles all CRT interface timing functions. The card also buffers the data to the microprocessor, and another circuit arbitrates access to RAM by the microprocessor and the CRT controller.

The LED latch driver is driven from the processor card. It also enables the cursor from screen to screen; CRT display enable; and two DC relay drivers driven from software. These are to be used as alarm relay contacts. Fusing for the CRT is on the card, along with failed fuse LED indicators.

NOTE: You can install the card in a cage, along with a Coordinator Processor, and a Power Regulator to determine if the card is good.

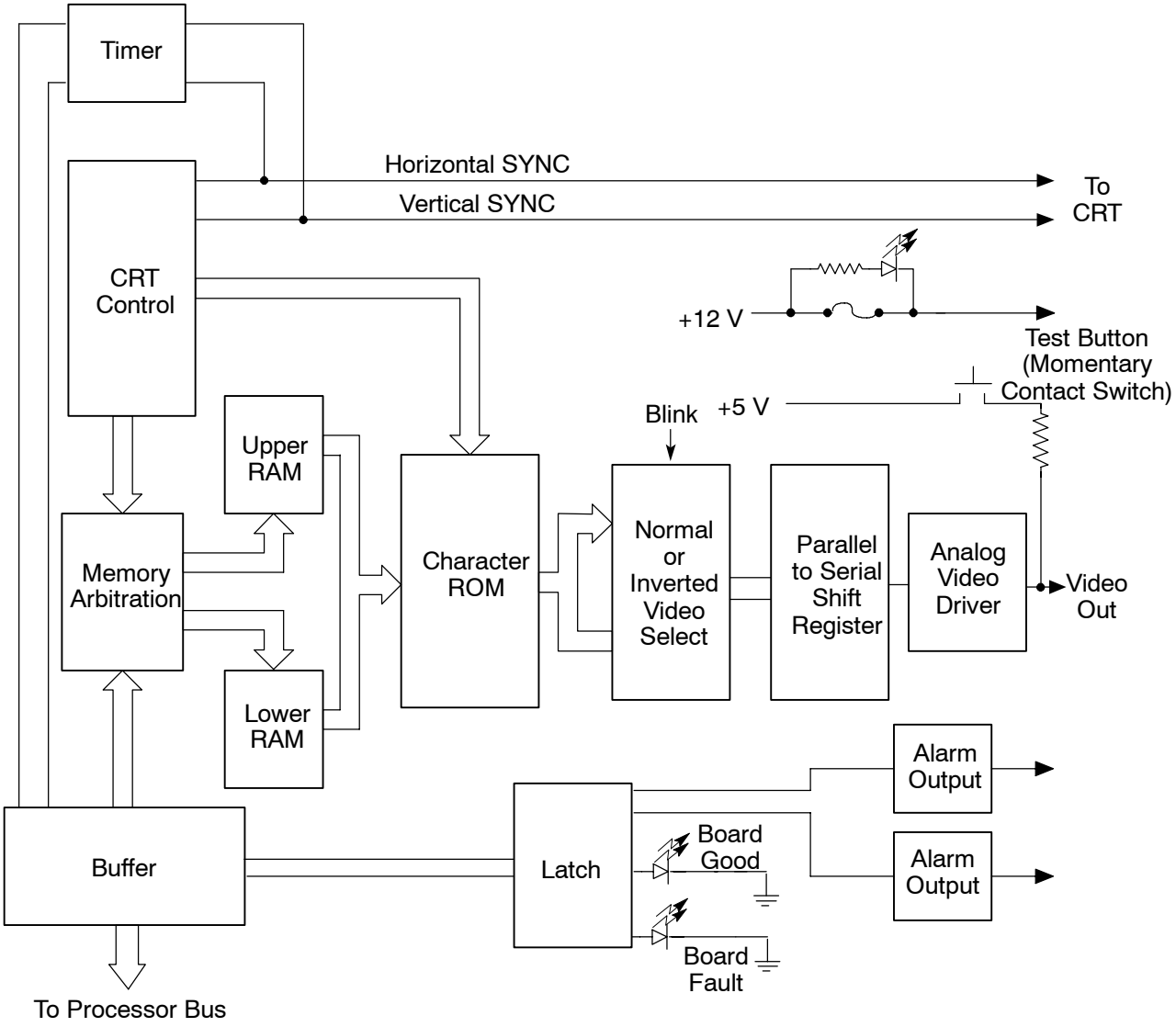
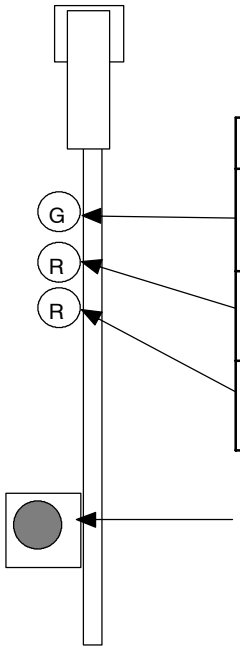


Figure 3.3.4. Monochrome Video Generator Functional Diagram

Monochrome Video Generator LEDs

The monochrome Video Generator card has LEDs to determine the card status. Figure 3.3.5 shows the LEDs for the Monochrome Video Generator card.



LED	Meaning
(DS1)	Card good. No faults are detected on the video generator card. Controller processor lights DS1 when power up diagnostics are completed.
(DS2)	Card fault. DS2 lights if the video generator card does not pass power up diagnostics.
(DS3)	Indicates that fuse F1 is bad. F1 supplies 12 volts to the CRT MONITOR.

Figure 3.3.5. Monochrome Video Generator LEDs

Monochrome Video Generator Raster Test Button

A momentary ON pushbutton, called the Raster Test Button, forces a raster on the screen to help distinguish between a failed Video Generator card or a failed CRT. Figure 3.3.5 shows the location of the test button.

Monochrome Video Generator Fuse

The monochrome Video Generator card has a fuse in the 12 volt line to the CRT. Figure 3.3.6 shows the location of the fuse. Table 3.3.1 gives fuse data.

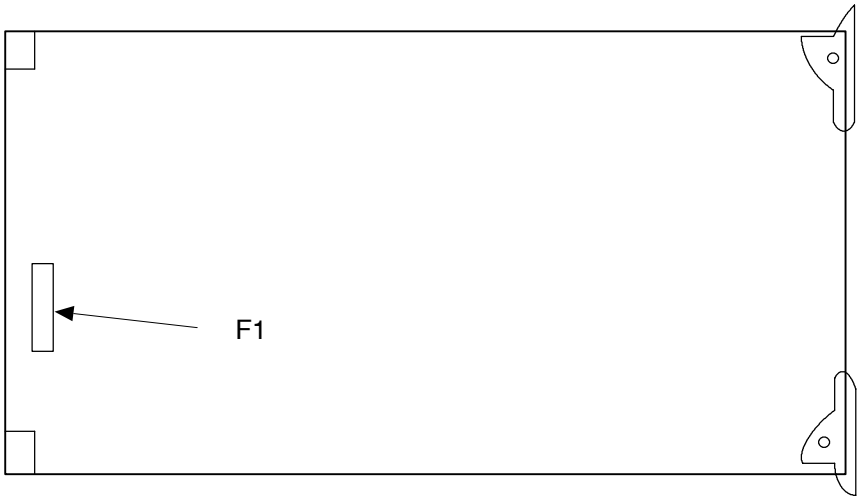


Figure 3.3.6. Monochrome Video Generator Fuse Location

Table 3.3.1. Monochrome Video Generator Fuse Data

Fuse	FRSI Part No.	Bussman Part No.	Littelfuse Part No.	Characteristics
F1	G09140–0032	MDL 2	313002	2 A 250 V Slow Blow

MiniConsole CRT

The MiniConsole CRT (1984-0672-000x) is a green phosphor, 9-inch monitor. It requires 12 volts DC for power and TTL level signals for the horizontal and vertical signals. The video drive is analog and the intensity is remotely controlled by increasing or decreasing the drive amplitude to change the CRT brightness. The CRT will not accept composite video.

There is one circuit card that has all components mounted except the CRT and yoke.

MiniConsole Printer Interface

The Printer Interface card (1984-1011-000x) is described in section 5 of this chapter.

MiniConsole Floppy Disk Drive

The MiniConsole 5.25-inch Floppy Disk Drive is described in this chapter, Section 5, “Disk and Tape Drives”.

MiniConsole Floppy Interface (SCSI)

The Floppy Interface (SCSI) (1984–1053–000x) is marked “OI MINI FLOPPY DISK CONTROLLER” on the PWA. The board controls the 5.25-iinch floppy disk drives used with the MiniConsole.

The interface card provides interface and data buffering between the Processor and the Floppy Disk Drives. Figure 3.3.7 shows a block diagram of the card.

This is an intelligent controller used to transfer data to and from the disk drives. The Processor tells the interface which drive, track and sector to use, whether to read or write, and the interface does the rest. Data to and from the drives is in the Non-Return to Zero (NRZ) format.

The disk drives need +5 VDC and +12 VDC to operate. Both voltages are supplied from the console Power Regulator board. Older MiniConsoles that use the 1984–1017–000x Power Regulator also use the 1984–1050–000x Floppy Disk Power Supply for +12 VDC power.

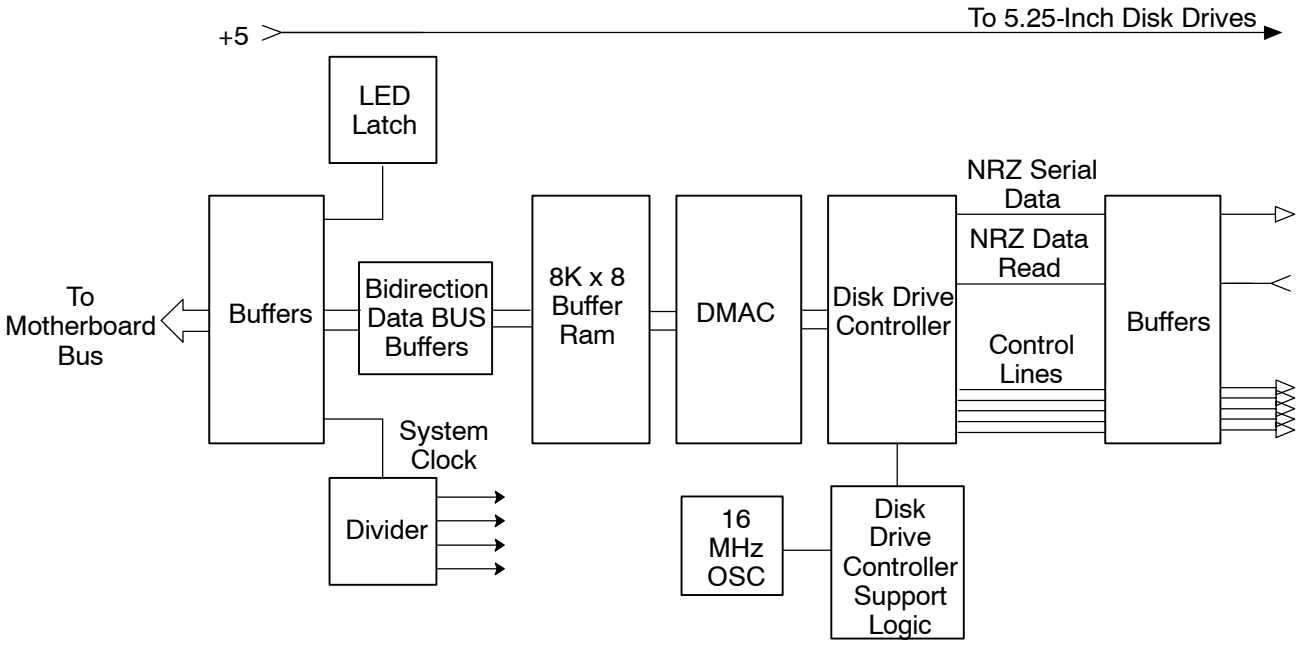


Figure 3.3.7. Floppy Interface (SCSI)

MiniConsole Floppy Interface (SCSI) LEDs

Figure 3.3.8 shows the LEDs on the Floppy Interface board.

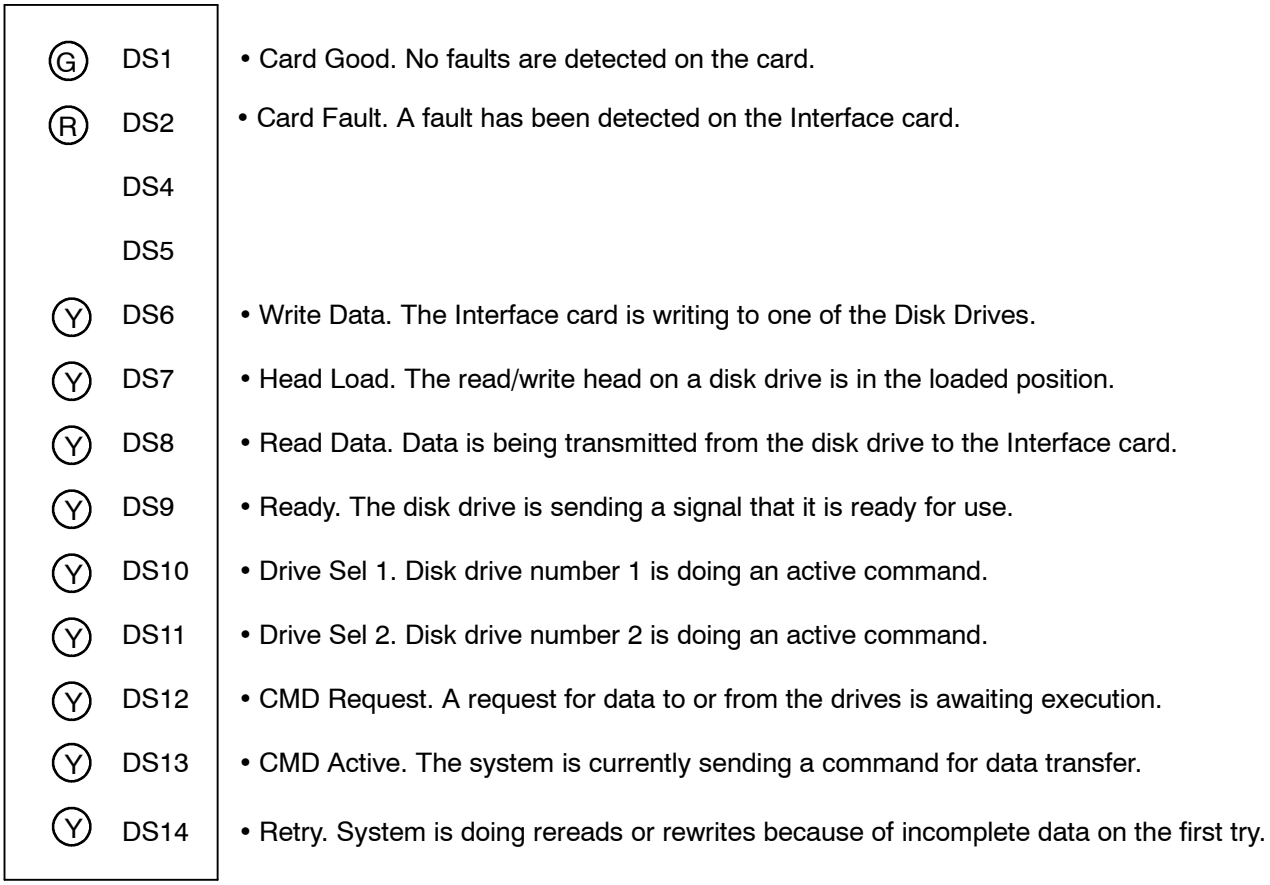

G DS1
• Card Good. No faults are detected on the card.
R DS2
• Card Fault. A fault has been detected on the Interface card.
DS4
DS5
Y DS6
• Write Data. The Interface card is writing to one of the Disk Drives.
Y DS7
• Head Load. The read/write head on a disk drive is in the loaded position.
Y DS8
• Read Data. Data is being transmitted from the disk drive to the Interface card.
Y DS9
• Ready. The disk drive is sending a signal that it is ready for use.
Y DS10
• Drive Sel 1. Disk drive number 1 is doing an active command.
Y DS11
• Drive Sel 2. Disk drive number 2 is doing an active command.
Y DS12
• CMD Request. A request for data to or from the drives is awaiting execution.
Y DS13
• CMD Active. The system is currently sending a command for data transfer.
Y DS14
• Retry. System is doing rereads or rewrites because of incomplete data on the first try.

Figure 3.3.8. Floppy Interface (SCSI) LEDs

Floppy Disk Power Supply

The Floppy Disk Power Supply (1984-1050-000x) provides 12 volt power to the drives and serves to connect the various cables. The card mounts on the top of the MiniConsole chassis and is connected to the console via one power cable, as shown in Figure 3.3.9.

NOTE: Used only on MiniConsoles that use the 1984-1017-0001 Power Regulator card.

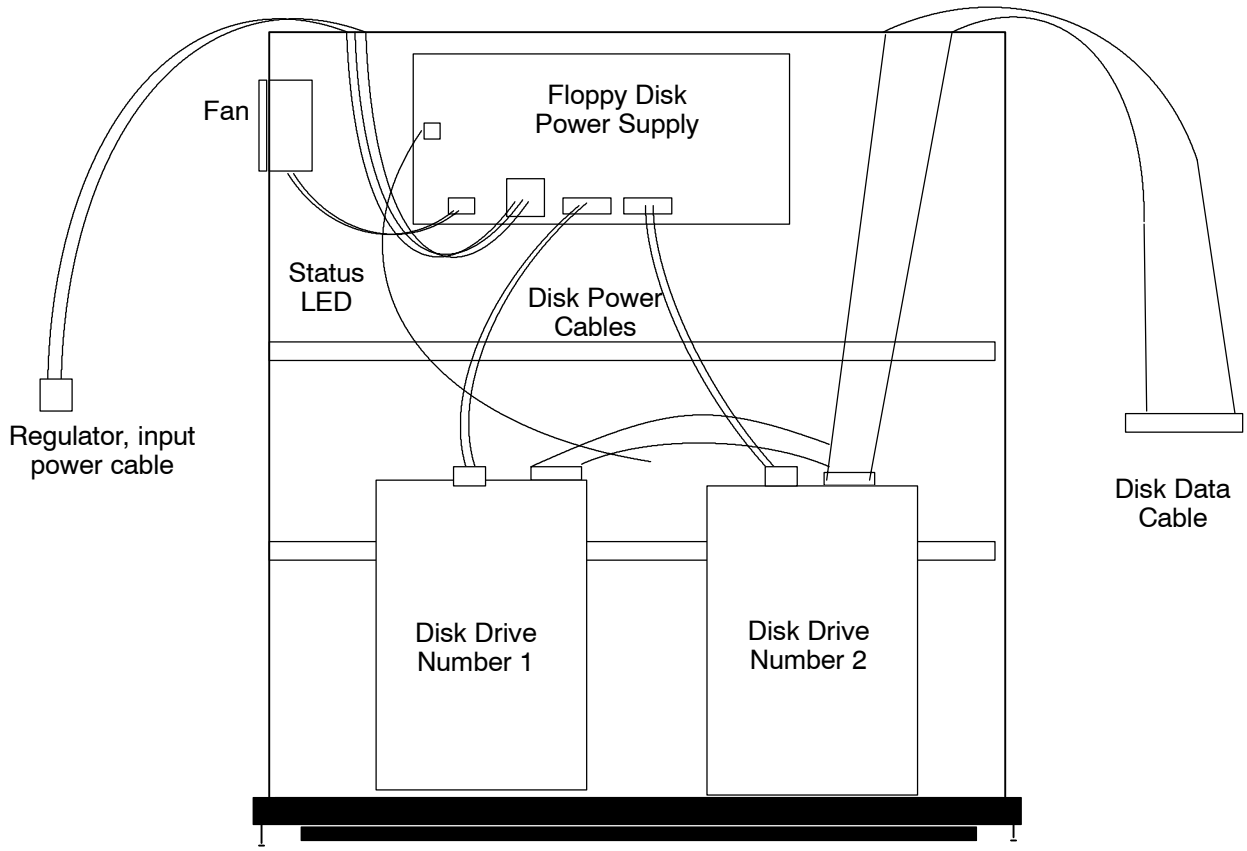


Figure 3.3.9. MiniConsole Floppy Disk Drives (With 1984-1017-0001 Power Regulator Only)

The Floppy Disk Power Supply regulates the 30 volt bus to provide the 12 volts needed to power the two disk drives. Figure 3.3.10 shows a block diagram of the card. No provisions are made to communicate the power fail status bits to the Console Processor. However, a front panel red/green LED is mounted on the disk drive assembly to indicate power good or bad.

30 volts is provided through isolating diodes from the A and B supplies and is fused on the card. The power regulator is a flyback switching type that is capable of supplying 12 volts output throughout the full power input specification of 19 to 36 volts. The voltage to the regulator chip is pre-regulated to 14 volts through a simple zener transistor regulator. Two operational amplifiers are used for integrating and filtering the output voltage to the regulator for optimum voltage control. Current is limited to 3 amps and overvoltage protection is accomplished using an overvoltage protection chip driving an Silicon-Controlled Rectifier (SCR).

A voltage comparator monitors the output voltage in comparison to a stable temperature compensated reference zener. It uses a single red/green LED to indicate if the output voltage is out of tolerance. This circuit is powered by +5 V and is independent of +12 V changes. If the LED goes out, the +5 V fuse has blown on the disk drive. Two power connectors are provided for the two disk drives.

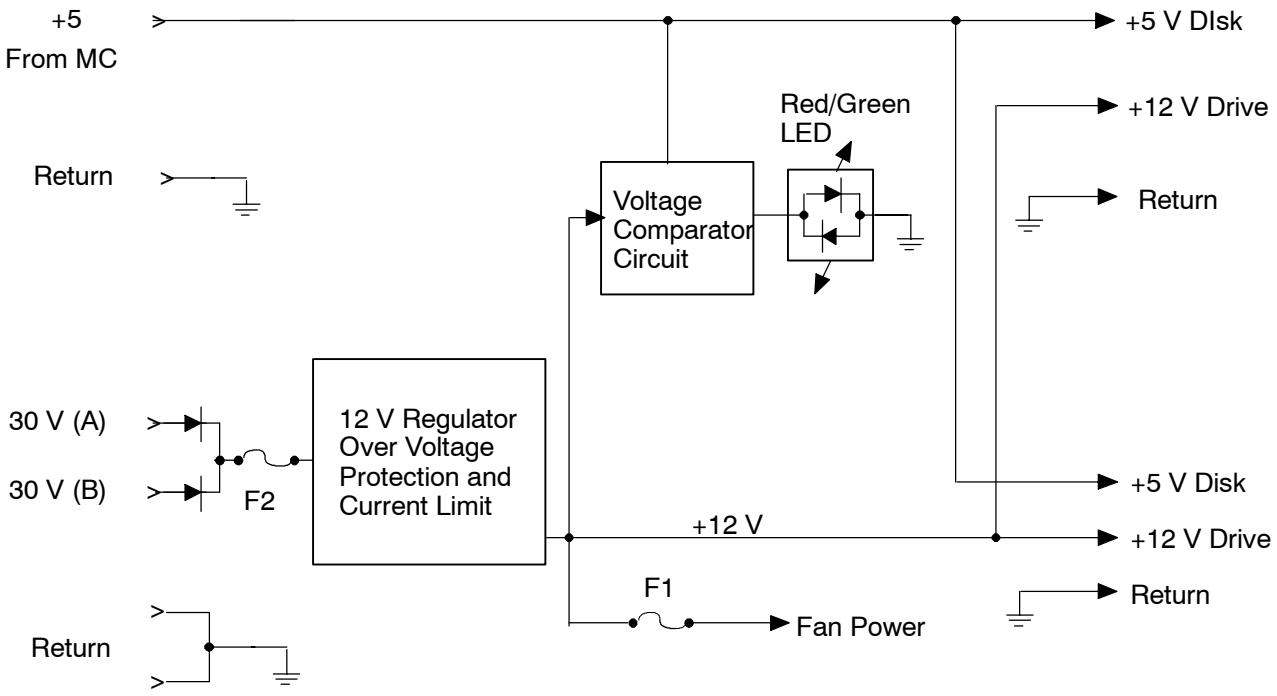


Figure 3.3.10. Floppy Disk Power Supply Block Diagram (With 1984-1017-0001 Power Regulator Only)

Floppy Disk Power Supply Fuses

Figure 3.3.11 shows the location of the fuses on the Floppy Disk Power Supply. Table 3.3.2 gives fuse data.

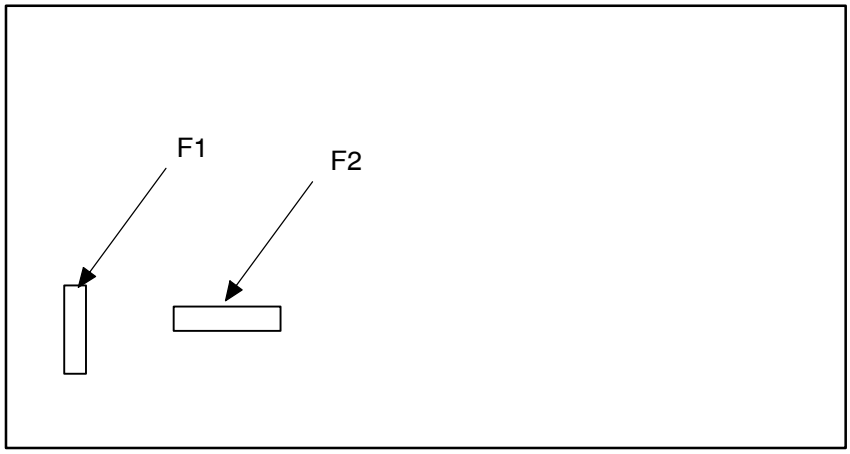


Figure 3.3.11. Floppy Disk Power Supply Fuse Location

Table 3.3.2. Floppy Disk Power Supply Fuses

Fuse	FRSI Part No.	Bussman Part No.	Littelfuse Part No.	Characteristics
F1	G09140-0011	MDQ 1/4	313.250	1/4 A 250 V Slow Blow
F2	G09140-0045	AGC 8	- -	8 A 250 V Regular

Remote MiniConsole Power Supply

The Remote MiniConsole Power Supply (1984-1089-000x) is described in Section 2 of Chapter 1.

Section 4:
RS3 Operator Station

This section describes the RS3 Operator Station (ROS) hardware. It covers:

- RS3 Operator Workstation
- Operator Keyboard
- Ethernet Cable
- RS3 Network Interface (RNI)
- Ethernet Hubs
- Router
- Uninterruptible Power Supply (UPS)

RS3 Operator Workstation

The workstation (Figure 3.4.1) consists of a computer, keyboard, mouse, CRT, and speakers. The workstation (10P5627xxxx – 166 MHz and 10P5693xxxx –200 MHz) can also have a tape drive, a printer, and an optional operator keyboard.

The workstation personal computer is shipped with installation and service manuals provided by the PC manufacturer.

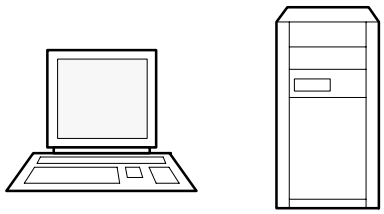


Figure 3.4.1. RS3 Operator Station PC

The workstation requires:

- An AC power source for the PC, CRT, speakers, and printer
- A hardware keylock device (supplied with the software)
- A 10BaseT Ethernet cable to the hub or RNI
- Uninterruptible power system (UPS)
  Two suitable uninterruptible power systems are:
  - Liebert Power Sure PS600–60 (NRTL)
  - Liebert Power Sure PS600–50 (CE)

At least one workstation on the process network should have these peripheral devices:

- A tape drive for backup of all workstations on the process network
- A printer that can be used by any workstation on the process network

The optional tape drive is a 3200 MB Travan. Refer to the tape drive user's manual.

The optional printer is a HP870Cxi Color Printer (10P55800004). This printer has an auto-sensing universal Power supply for 100–240 VAC, 50/60 Hz. The software printer driver is the HP560 driver in Windows NT. The printer cable number is 10P55800003. Refer to the printer user's manual.

ROS CRTs

The color CRT monitors that can be used with the RS3 Operator Station include:

- 21-inch Hitachi HM-4721-D CRT
- 17-inch Iiyama Vision Master CRT

ROS CRT: Hitachi HM-4721-D

The Hitachi HM-4721-D CRT (12P0373x032) is a 21-inch color unit.

The unit runs on either 115 or 220 VAC, 50 or 60 Hz (100-120 / 200-240 VAC auto selecting).

Setup and controls are described in the user manual that accompanies the unit.

ROS CRT: Iiyama Vision Master

The Iiyama Vision Master CRT (55P0144x022) is a 17-inch color unit.

The unit runs on either 115 or 220 VAC, 50 or 60 Hz (108-132 / 198-264 VAC auto selecting).

Setup and controls are described in the user manual that accompanies the unit.

ROS Operator Keyboard

The RS3 Operator Station has a variety of keyboard options. Figure 3.4.2 shows the dimensions of the optional operator keyboard with a single option button panel. Up to three option button panels may be provided.

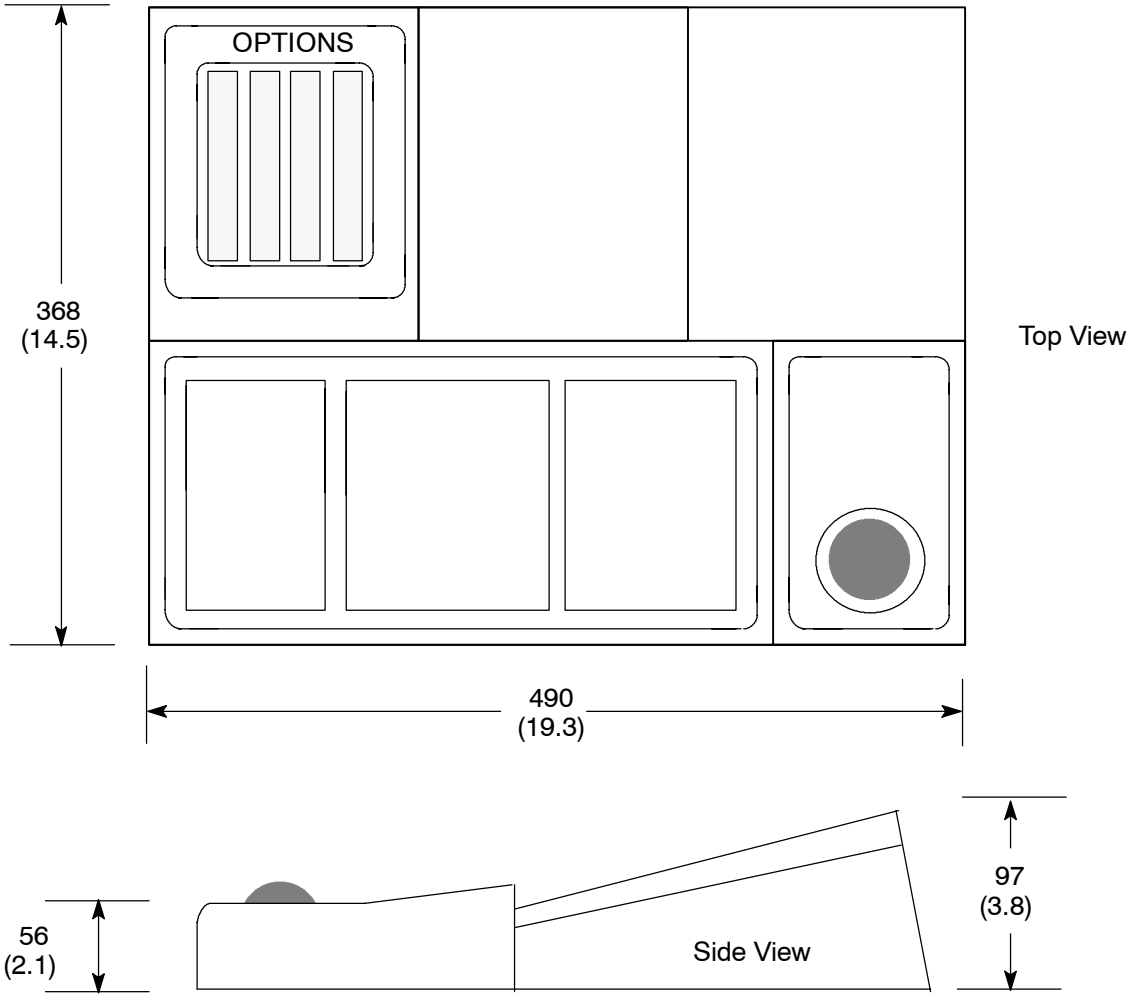


Figure 3.4.2. Elevated Operator Keyboard Dimensions in Millimeters (Inches)

Figure 3.4.3 shows the dimensions of the operator keyboard with trackball.

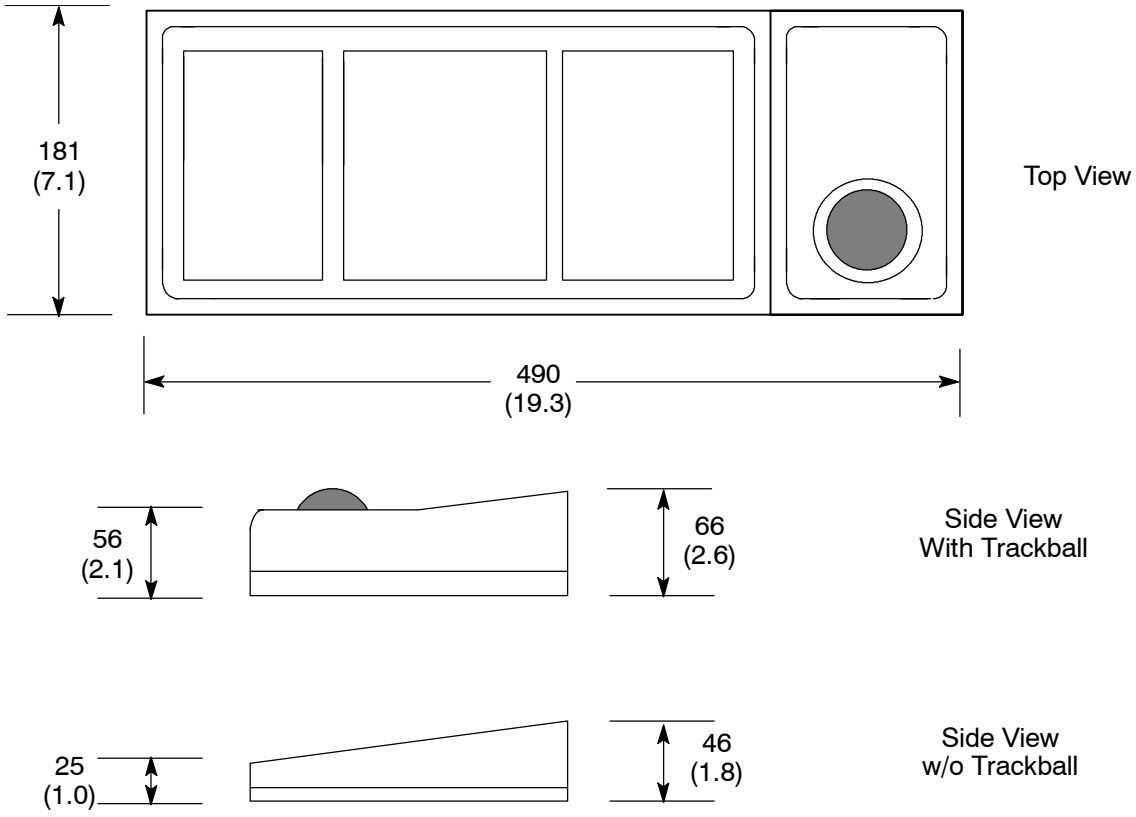


Figure 3.4.3. Operator Keyboard Dimensions in Millimeters (Inches)

ROS Operator Keyboard Interface Circuit Board (10P56910001)

CAUTION

Observe normal electrostatic discharge (ESD) precautions when handling the keyboard interface circuit board. Observe the ESD precautions in your computer manual when installing the board in the computer.

Interface card dip switch settings are shown in Figure 3.4.4.

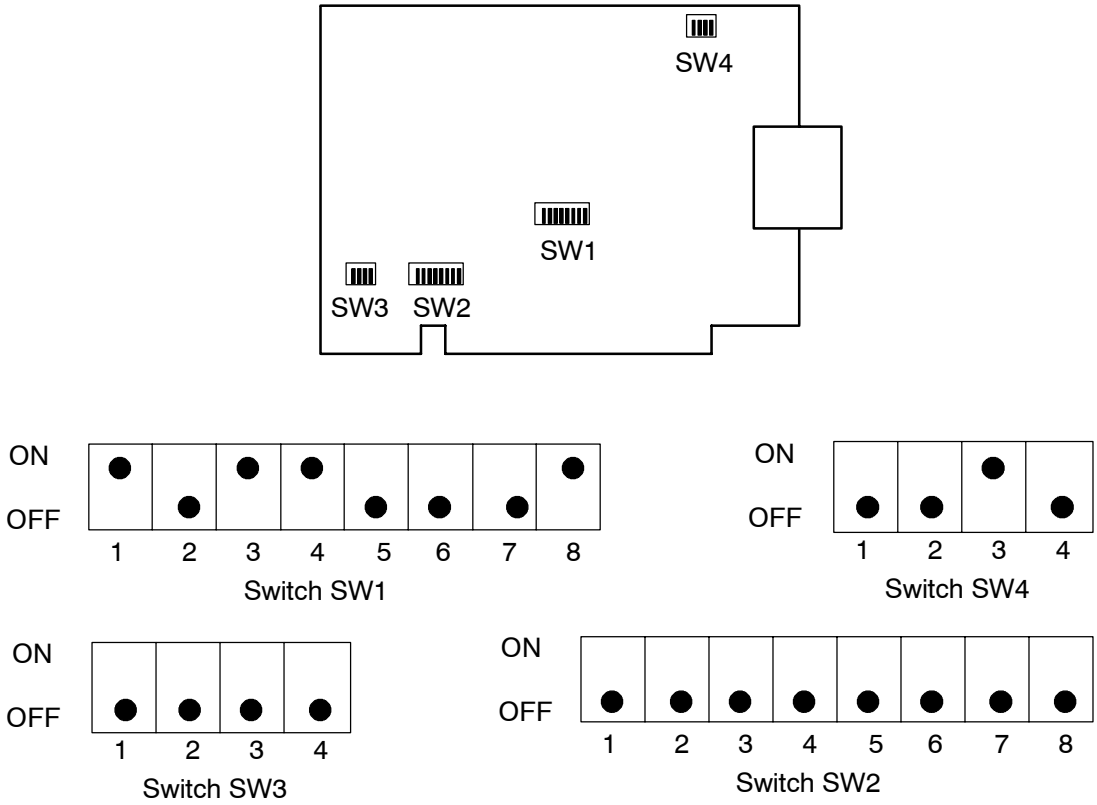


Figure 3.4.4. ROS Operator Keyboard Interface Card

ROS Operator Keyboard Connections

The 9-pin D-sub connector end of interface cable 10P56700015 (Figure 3.4.5) is connected to the keyboard interface card serial port on the back of the PC.

The 8-pin connector end of the interface cable is connected to the standard keyboard cable.

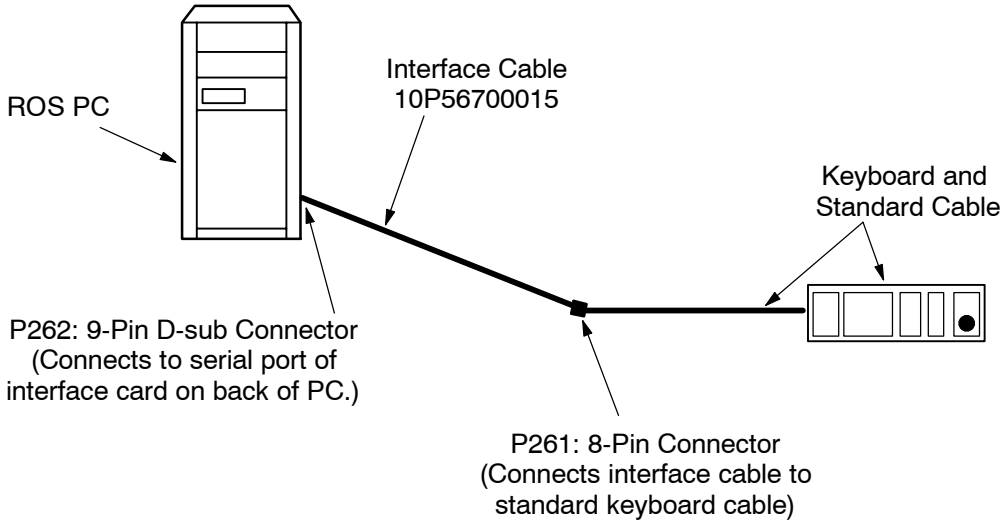


Figure 3.4.5. ROS Operator Keyboard Interface Connection

Ethernet Cable

The RS3 process network uses 10BaseT cable. 10BaseT cable uses two pairs of 0.14 – 0.34 mm^2 (22 – 26 AWG) wires, one pair to transmit and one to receive data signals. The wires in each pair are twisted together along the length of the cable. This allows segment lengths of up to 100 meters (328 feet). There are two additional pairs of wires in the cable that can be used for telephone or other use. The cable has an 8-pin RJ-45 connector at each end.

- Category 5 cable in plenum grades must be used
- Cables must be routed away from power lines or other sources of interference

NOTE: For CE-compliant applications, shielded 10BaseT cable is required.

Stranded-wire cable is suitable only for short runs where flexibility is required. Cable is available with color-coded jackets, with or without connectors.

Standard cable (for use with a hub) has the connection wired straight through. Crossed cable is available with the transmit and receive cables crossed over for “null modem” connections. Crossover cable is used only when a workstation is connected directly to an RNI without a hub.

RS3 Network Interface (RNI)

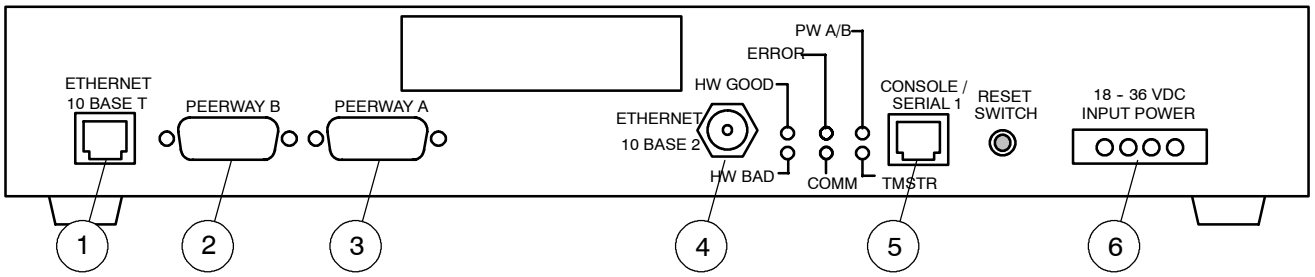
The RS3™ Network Interface (RNI) (10P53330001) provides a connection between the PeerWay and an Ethernet Local Area Network. It is a node on the PeerWay and a host on the Ethernet. Software in the RNI provides a connection between PeerWay messages and Ethernet messages.

Service issues are covered in the *Service Manual* (SV), Volume 2.

The RNI (Figure 3.4.6) requires:

- A DC power source (18–36 V)
- An Ethernet 10BaseT cable to the hub or workstation
- PeerWay Drop cables to the PeerWay Tap Box set

All connections are made to the front of the RNI as shown below.



No.	Item	No.	Item
1	Ethernet 10BaseT connector	4	Ethernet 10Base2 connector (not used)
2	PeerWay B drop cable	5	Console/Serial connector (for field service use)
3	PeerWay A drop cable	6	DC power connector to RS3 DC power bus

Figure 3.4.6. RS3 Network Interface

The write-on label (Figure 3.4.7) provides space to record the PeerWay Node address of the RNI, the Ethernet host name of the RNI, and which Ethernet port is in use. The MAC Address (machine address) will be filled out at the factory. This is the unique Ethernet address of the RNI.

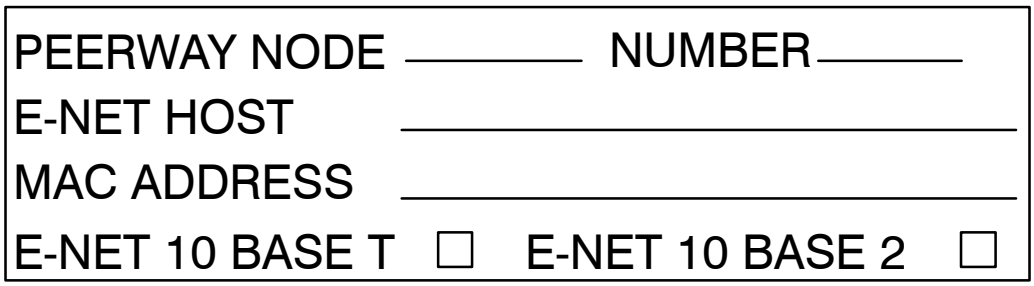


Figure 3.4.7. RNI Write-on Label

Ethernet Hubs

A hub provides the common connection point for devices on the process network and a connection to the plant LAN. Fisher-Rosemount supports use of these hubs from the 3Com LinkBuilder™ series:

- TP/8 8-port Unmanaged TP Hub (10P55200001 – 115V)
- FMS II 12-Port TP Hub
  (10P55200002 – Autosensing power supply)
- FMS II 24-port TP Hub
  (10P55200003 – Autosensing power supply)

The hubs require a source of AC power.

NOTE: The material below has been freely adapted from 3Com product literature.

TP/8 Hub

The LinkBuilder TP/8 (3C16180) is a basic twisted-pair hub offering cost-effective connectivity for small process networks. It does not support network management. The TP/8 Hub:

- Provides eight RJ-45 ports
- Can be connected to another TP/8 hub to provide fourteen RJ-45 ports
- Provides one thin coaxial (BNC) port for backbone connections
- Provides full compliance with IEEE 802.3 10BaseT standards
- Has LED status indicators which make faults easy to identify
- Has bandwidth utilization LEDs to show network utilization
- Is powered by an external AC power adapter

FMS II Hubs

The LinkBuilder FMS II (Flexible Media Stack) hub family provides the features needed for larger process networks. Up to eight hubs can be stacked as a single repeater. TP and fiber-optic hubs can be mixed in the stack. Options provide network management connections to the plant LAN. Two versions of LinkBuilder FMS II hubs are used:

- 12-Port TP (3C16670A) 12 shielded RJ-45 TP connectors
- 24-Port TP (3C16671A) 24 shielded RJ-45 TP connectors

The FMS II hubs are equipped with a standard attachment unit interface (AUI) port and a slot for a plug-in Transceiver Interface Module. The 12-Port TP hub can use either the AUI port or the transceiver port, the 24-Port hub can use both.

Each LinkBuilder FMS II hub includes LEDs for power status, packet reception, packet collision, network management, and hub ID. Each port has LEDs for partition and link status.

All LinkBuilder FMS II hubs offer:

- Simple Network Management Protocol (SNMP) management: Accepts optional network management modules.
- RMON Management: Standard Remote Monitoring (RMON) automates network management to reduce network traffic and errors.
- Built-in security: Easy-to-enable security features can be used to protect data and LAN resources.
- Media choices: You can create mixed-media stack with 12-port and 24-port RJ-45 twisted-pair hubs and 6-port ST fiber hubs.
- Backbone choices: Backbone links include a standard attachment unit interface (AUI) port, plus optional Transceiver Interface Modules for AUI, BNC coaxial, ST fiber, and twisted-pair connections.

LinkBuilder FMS II hubs are equipped with a number of simple-to-use features that help safeguard the network against security breaches. As part of the 3Com patented LAN Security Architecture, these security features come standard with the hubs:

- Need To Know: Protects sensitive data on the network by checking destination addresses on each packet and sending readable packets only to authorized nodes.
- Disconnect Unauthorized Device: If an unauthorized device attempts to log on, the hub automatically records and/or disables it and logs the event at the management station.
- Audit Log: Automatically tracks changes involving users and devices on the network, giving the manager a complete record.
- Multiple User Levels ensure that only authorized users have access to critical network functions. Passwords can be used to identify network managers.

RMON support comes standard with FMS II hubs, and allows industry standard tracking, storing and analysis of network traffic, as well as powerful diagnostic capabilities. The RMON agent reduces the SNMP traffic over LAN and Wide Area network (WAN) connections, and improves response time on the SNMP workstation and reduces costs. SmartAgents™ enhance RMON by adding autocalibration of thresholds, actions, and events.

Hub Accessories

Accessories for the FMS II hub family allow addition of network management and additional connection configurations. They include:

- FMS II Network Management Module
- Transceiver Interface Modules

These modules are not available from FRSI.

FMS II Network Management Module

The FMS II Network Management Module (3C16630) provides SNMP (Simple Network Management Protocol) capabilities for all hubs in the stack. Smart-Agent intelligent agents automatically gather and collate critical information and minimize network management traffic.

The module fits internally and does not use any of the slots or connectors on the hub. The network management card has its own Ethernet and IP address. Only one network management card is needed in a stack of up to eight hubs. This module is not available from FRSI.

Transceiver Interface Modules

A Transceiver Interface Module can be plugged into any FMS II hub to provide connections for fiber and coaxial cables. Available modules include:

- Twisted pair (3C12063) one RJ-45 connector
- BNC coaxial (3C1206–6) one BNC connector
- ST fiber (3C1206–5) two ST connectors
- Fan-Out (3C1206–4) one male AUI connector
- AUI (3C1206–0) one female AUI connector

These modules are not available from FRSI.

The fiber-optic transceiver can be used to provide additional fiber optic ports on a fiber-optic hub or to provide a fiber-optic port on a twisted pair hub.

Hub Specifications

All hubs accept 115 or 230 VAC, 50 to 60 Hz. The FMS II hubs are autosensing. The TP/8 hub requires a power pack specified for voltage and frequency.

They can operate over 0 to 50°C (32 to 122°F) with up to 90% humidity (noncondensing) and be stored in –22 to 60°C (–30 to 140°F) with 10% to 90% humidity (noncondensing). Hub specifications are listed in Table 3.4.1

Table 3.4.1. Hub Specifications

Hub	Dimensions	Weight	Power, Heat
TP/8	20.1 x 2.7 x 11.1 cm (8 x 1 x 4.5 in.)	0.57 kg (1.25 lb)	6.5 W 22.2 BTU/hr
FMS II 12-port TP	44 x 30.4 x 6.6 cm (17.5 x 9 x 1.66 in.)	2.6 kg 5.75 lb)	28 W 100 BTU/hr
FMS II 24-port TP	44 x 30.4 x 6.6 cm (17.5 x 9 x 1.66 in.)	2.7 kg (6 lb)	36 W 123 BTU/hr

Router

When connecting to a plant network, a router must be used to isolate your process network. Which to chose depends heavily on the nature of the plant network. Consult with your plant network administration or a knowledgeable networking service to select the proper connection mechanism for your installation.

Consult Fisher-Rosemount Systems for the recommended router.

CAUTION

The process network must be isolated from the plant network with a router. If it is not isolated, a misbehaving device on the plant network could cause loss of control on the process network.

Be sure to use the router's controlled access list functionality to provide isolation from network traffic.

Uninterruptible Power Supply (UPS)

The workstation must be powered from an uninterruptible power supply (UPS). Two suitable systems are the Liebert Power Sure PS600-60 (55P0566x012 - NRTL) and the Liebert Power Sure PS600-50 (55P0567x012 - CE).

The UPS should be able to signal when primary power fails and when the battery is getting low. This signal is carried by cable to a dedicated serial port on a workstation computer. The NT operating system can be configured to warn users of power failure and to shut down the system when the UPS batteries are low. With the Liebert Power Sure PS600-60 (NRTL) or the Liebert Power Sure PS600-50, cable 10P56820001 (WIN-NEG-48A) is connected from COM2 on the PC to the communications port on the UPS.

The UPS should be sized to operate the equipment for at least five minutes to allow for an orderly shutdown. The minimum volt-ampere rating for a UPS on a single workstation is 600 VA. Table 3.4.2 lists typical power consumption examples.

Table 3.4.2. Typical Power Consumption Examples

Item	Typical Power Consumption (Watts)
PC	200
17-Inch CRT	130
21-Inch CRT	250
Printer	12
TP/8 Hub	10
FMS II 12-Port Hub	28
FMS II 24-Port Hub	36

UPS Software Setup

Windows NT (under Control Panel) provides the UPS configuration software. In order to make changes to the UPS configuration you must be logged in as an NT Administrator.

With the Liebert Power Sure PS600-60 (NRTL) or the Liebert Power Sure PS600-50, the following configuration should be set:

- Select Uninterruptible Power Supply is installed on: COM2

Under UPS Configuration:

- Select Power failure signal (select Negative for UPS Interface Voltages).
- Select Low battery signal: at least 2 minutes (select Negative for UPS Interface Voltages).
- Select Remote UPS Shutdown (select Positive for UPS Interface Voltages).

Under UPS Service:

- Set Time between power failure and initial warning message to 0 seconds.
- Set Delay between warning messages to 30 seconds.
- Click on OK.

Section 5:
Disk and Tape Drives

This section covers the disk and tape devices used with consoles and PeerWay interface devices:

- Hard disk drive (Winchester)
- Floppy disk drive
- Magnetic tape drive

Hard Disk Drive

Hard “Winchester” disks used with the Multitube Command Console, Pedestal Command Console, and System Resource Unit include:

- 10P58570001 Quantum QM32100, 2.1 Gigabyte
- 10P58050001 Quantum Thunderbolt, 540 Meg
- 10P5665000x 3.5-inch IBM Deskstar 540 (540 Meg Unformatted)
- 10P52800002 3.5-inch Quantum ProDrive® LPS 270S (270 Meg Unformatted)
- 1984–3500–000x 3.5-inch Quantum ProDrive® LPS 170S (170 Meg Unformatted)
- 1984–3100–000x 3.5-inch Quantum ProDrive® LPS 105S (102 Meg Formatted)
- 1984–2780–000x 3.5-inch Quantum ProDrive® 80S (100 Meg Unformatted)
- 1984–2307–000x 5.25-inch Quantum Q280 (100 Meg Unformatted)
- 1984–1928–000x 5.25-inch Quantum Q540 (40 Meg)

NOTE: The IBM Deskstar 540 and above requires minimum boot ROM and software versions.

Table 3.5.1 gives parts replacement data. Figure 3.5.1 shows a typical hard disk drive.

Table 3.5.1. Hard Disk Drive Parts Replacement

Part No.	Replaces	Characteristics
10P58570001		3.5-inch disk Quantum QM32100 2.1 Gigabyte Formatted
10P58050001		3.5-inch disk Quantum Thunderbolt 540 Meg Formatted
10P5665000x	10P52800002	3.5-inch disk IBM Deskstar 540 540 Meg Formatted
10P52800002	1984–3500–000x 1984–3100–000x	3.5-inch disk Quantum ProDrive LPS 270S 270 Meg Built-in SCSI
1984–3500–000x	1984–3100–000x	3.5-inch disk Quantum ProDrive LPS 170S 170 Meg Built-in SCSI
1984–3100–000x	1984–2780–000x 1984–2307–000x 1984–1928–000x	3.5-inch disk Quantum ProDrive LPS 105S 102 Meg Formatted
1984–2780–000x	1984–2307–000x 1984–1928–000x	3.5-inch disk Quantum ProDrive 80S 100 Meg Unformatted, 84 Meg Formatted
1984–2307–000x	1984–1928–000x	5.25-inch disk Quantum Q280 100 Meg Unformatted, 80 Meg Formatted
1984–1928–000x	Itself only	5.25-inch disk Quantum Q540 40 Meg Unformatted, 34 Meg Formatted

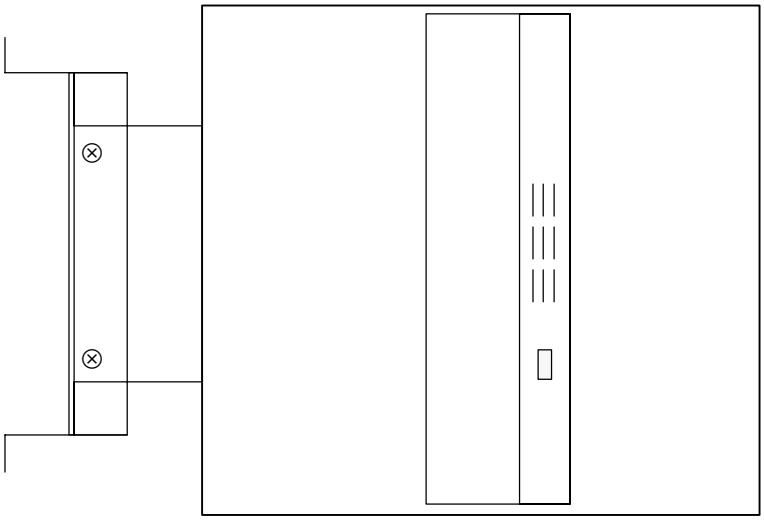


Figure 3.5.1. Hard Disk Drive (Front View)

Table 3.5.2 lists the DC power cable assemblies. Table 3.5.3 lists the specifications for cable 10P56840001 inline fuses.

Table 3.5.2. Hard Disk Drive DC Power Cable Assemblies

Part No.	Replaces	Characteristics
10P56840001	1054180001	CE Compliant with inline fuses. Required with IBM Deskstar drive
10P54180001	itself only	EMC Compliant
10P56909901	1984-1630-9901	Non-CE Multitube SCSI/KVI Power Cable
10P56909902	1984-1630-9902	Non-CE Multitube SCSI/KVI Power Cable 52”
1984-1630-9901	itself only	Non-CE Multitube Mem Power Cable
1984-1630-9902	itself only	Non-CE Multitube Mem Power Cable 52”

Table 3.5.3. Cable 10P56840001 Inline Fuses

Fuse	FRSI Part No.	Bussman Part No.	Littelfuse Part No.	Characteristics	Cable 10P56840001
F1 & F2	G01940–0046	AGC 10	311010	10 A 32 V Regular	Rev A
F1 & F2	G01940–0041	MTH 5	312005	5 A 250 V Regular	Rev B

Quantum QM32100

Table 3.5.4 shows values of the Quantum QM32100 jumpers.

Table 3.5.4. 10P58570001 Quantum Thunderbolt Drive Address Jumpers

Jumper	Factory Setting
A0	**ON** (Jumper)
A1	OFF (No Jumper)
A2	**ON** (Jumper)
PK	**ON** (Jumper)
TE	OFF (No Jumper)
+LED	**ON** (Jumper)
Reserved	**ON** (Jumper)

Warning

The metal frame of the disk drive must not make electrical contact with the mounting frame in the console. Use either the black coated mounting can or use mylar insulating pads between the drive and the yellow can.

Quantum Thunderbolt

Table 3.5.5 shows values of the Quantum Thunderbolt jumpers.

Table 3.5.5. 10P58050001 Quantum Thunderbolt Drive Address Jumpers

Jumper	Factory Setting
PO	**ON** (Jumper)
A0	**ON** (Jumper)
A1	OFF (No Jumper)
A2	**ON** (Jumper)

Warning

The metal frame of the disk drive must not make electrical contact with the mounting frame in the console. Use either the black coated mounting can or use mylar insulating pads between the drive and the yellow can.

IBM Deskstar 540

Table 3.5.6 shows values of the IBM Deskstar 540 jumpers.

Table 3.5.6. 10P5665000x IBM Deskstar 540 Jumpers

Jumper	Factory Setting
1	**ON** (Jumper)
2	OFF (No Jumper)
3	**ON** (Jumper)
4	OFF (No Jumper)
5	**ON** (Jumper)
6	**ON** (Jumper)
7	**ON** (Jumper)
8	OFF (No Jumper)
9	OFF (No Jumper)
10	OFF (No Jumper)
11	OFF (No Jumper)
12	OFF (No Jumper)

Warning

The metal frame of the disk drive must not make electrical contact with the mounting frame in the console. Use either the black coated mounting can or use mylar insulating pads between the drive and the yellow can.

DC power cable 10P56840001 is required with the IBM Deskstar 540 drive.

Quantum ProDrive LPS 270S

Table 3.5.7 shows values of the Drive Address Jumpers. They set the drive to address 5.

Table 3.5.7. 10P5280000x ProDrive LPS 270S Drive Address Jumpers

Jumper	Factory Setting
A0	**ON** (Jumper)
A1	OFF (No Jumper)
A2	**ON** (Jumper)

Warning

The metal frame of the disk drive must not make electrical contact with the mounting frame in the console. Use either the black coated mounting can or use mylar insulating pads between the drive and the yellow can.

Quantum ProDrive LPS 170S

Table 3.5.8 shows values of the Drive Address Jumpers. They set the drive to address 5.

Table 3.5.8. 1984-3100-000x ProDrive LPS 170S Drive Address Jumpers

Jumper	Factory Setting
A0	**ON** (Jumper)
A1	OFF (No Jumper)
A2	**ON** (Jumper)

Warning

The metal frame of the disk drive must not make electrical contact with the mounting frame in the console. Use either the black coated mounting can or use mylar insulating pads between the drive and the yellow can.

Quantum ProDrive® LPS 105S 3.5-Inch 102 Meg Hard Disk

Table 3.5.9 shows the factory setting of the 1984-3100-0001 Quantum ProDrive LPS 105S Drive Option jumpers. These jumpers should not be changed.

Table 3.5.9. 1984-3100-000x Productive LPS 105S Drive Option Jumpers

Jumper	Purpose	Factory Setting
WS	Wait Spin Option	OFF (No Jumper)
EP	Enable Parity Option	**ON** (Jumper)
SS	Self Seek Test Option	OFF

Table 3.5.10 shows values of the Drive Address Jumpers. They set the drive to address 5.

Table 3.5.10. 1984-3100-000x ProDrive LPS 105S Drive Address Jumpers

Jumper	Factory Setting
A0	**ON** (Jumper)
A1	OFF (No Jumper)
A2	**ON** (Jumper)

Warning

The metal frame of the disk drive must not make electrical contact with the mounting frame in the console. Use either the black coated mounting can or use mylar insulating pads between the drive and the yellow can.

Quantum ProDrive® 80S 3.5-Inch 100 MB Hard Disk

Table 3.5.11 shows the factory setting of the 1984–2780–000x Quantum ProDrive 80S Drive Option jumpers. These jumpers should not be changed.

Table 3.5.11. 1984–2780–000x ProDrive 80S Drive Option Jumpers

Jumper	Purpose	Factory Setting
WS	Wait Spin Option	OFF (No Jumper)
EP	Enable Parity Option	**ON** (Jumper)
SS	Self Seek Test Option	OFF

Table 3.5.12 shows values of the Drive Address Jumpers. These should be set to drive address 5.

Table 3.5.12. 1984–2780–000x Productive 80s Drive Address Jumpers

Jumper	Factory Setting
A0	**ON** (Jumper)
A1	OFF (No Jumper)
A2	**ON** (Jumper)

Warning

The metal frame of the disk drive must not make electrical contact with the mounting frame in the console. Use either the black coated mounting can or use mylar insulating pads between the drive and the yellow can.

Figure 3.5.2 shows the address jumper positions for a drive address of 5.

Figure 3.5.2. 1984–2780–000x ProDrive 80S Jumper Positions

There are three small computer system interface (SCSI) terminating resistors that remain in place unless the drive is not the last unit on the SCSI bus. Figure 3.5.3 shows the location of jumpers and terminating resistors.

CAUTION

It is possible to put the logic cable on incorrectly even though it is keyed. The cable should be installed with pin 1 (red wire) on the end of the plug nearest to the center of the board.

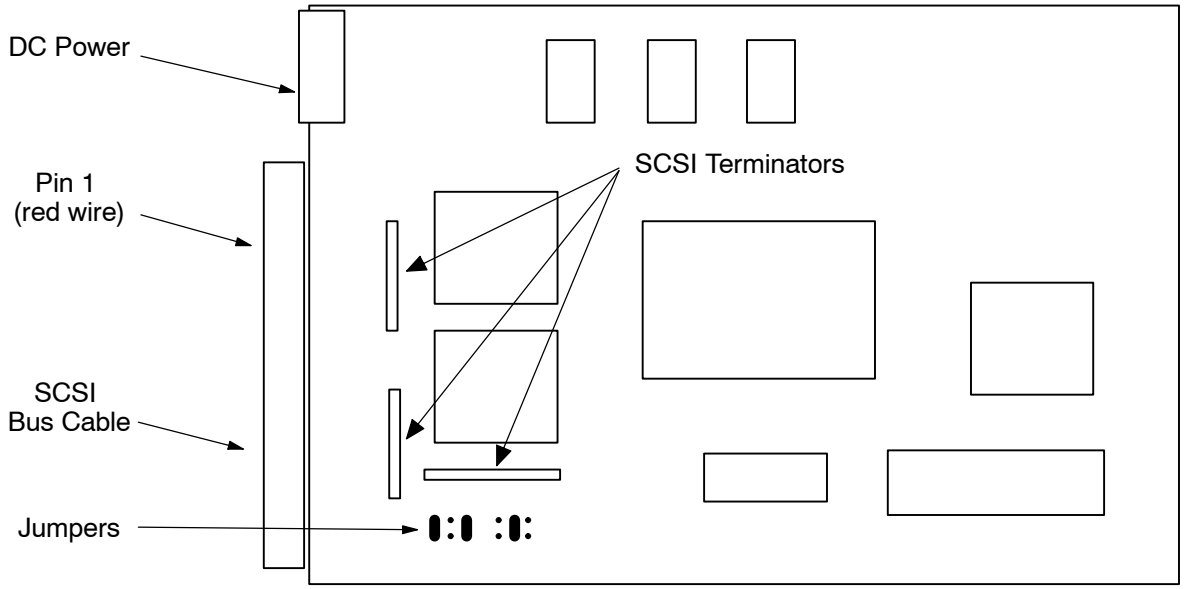


Figure 3.5.3. 1984-2780-000x ProDrive 80S Drive Jumpers and Terminators

Quantum ProDrive® Q280 5.25-Inch 100 MB Hard Disk

The 1984–2307–000x Quantum ProDrive Q280 5.25-Inch 100 MB Hard Disk is a half-height unit with built in SCSI board. When formatted it holds 80 MB. There are two versions of the drive.

Version 1:

Table 3.5.13 shows the factory setting of the 1984–2307–000x Quantum ProDrive Q280 Version 1 Drive Option jumpers. These jumpers should not be changed.

Table 3.5.13. 1984–2307–000x Q280 Version 1 Drive Option Jumpers

Jumper	Purpose	Factory Setting
WS	Wait Spin Option	OFF (No Jumper)
EP	Enable Parity Option	**ON** (Jumper)
SS	Self Seek Test Option	OFF
R0		OFF
P1	No function	**ON**

Version 2:

Table 3.5.14 shows the factory setting of the 1984–2307–000x Quantum ProDrive Q280 Version 2 Drive Option jumpers. These jumpers should not be changed.

Table 3.5.14. 1984–2307–000x Q280 Version 2 Drive Option Jumpers

Jumper	Purpose	Factory Setting
WS	Wait Spin Option	OFF (No Jumper)
EP	Enable Parity Option	**ON** (Jumper)
SS	Self Seek Test Option	OFF
P1	No function	**ON**
P2	No function	**ON**

Table 3.5.15 shows values of the Drive Address Jumpers. Only address 5 is valid.

Table 3.5.15. 1984-2307-000x Q280 Drive Address Jumpers

Drive Address	Jumper A0	Jumper A1	Jumper A2
0	OFF (No Jumper)	OFF	OFF
1	**ON** (Jumper)	OFF	OFF
2	OFF	**ON**	OFF
3	**ON**	**ON**	OFF
4	OFF	OFF	**ON**
5	**ON**	OFF	**ON**
6	OFF	**ON**	**ON**
7	**ON**	**ON**	**ON**

There are three SCSI terminating resistors that remain in place unless the drive is not the last unit on the SCSI bus. Figure 3.5.4 shows the location of jumpers and terminating resistors.

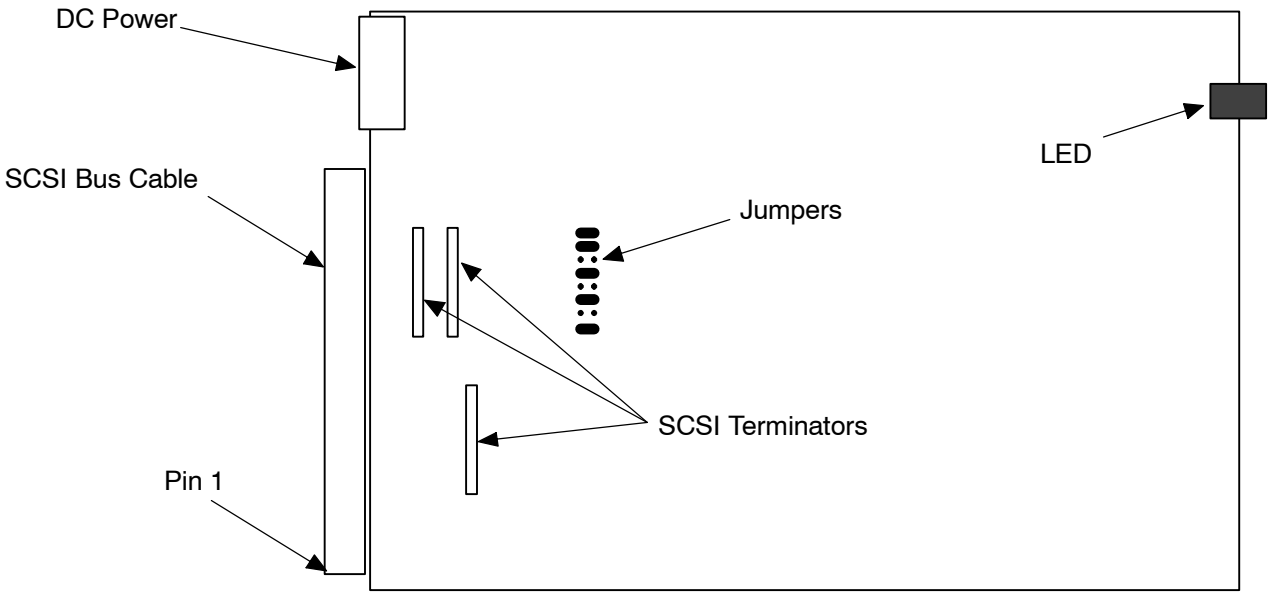


Figure 3.5.4. 1984-2307-000x Quantum Q280 Drive Jumpers and Terminators

Quantum ProDrive® Q540 5.25-Inch 40 MB Hard Disk

Table 3.5.16 shows jumper settings for the 1984–1928–000x 40 Meg “Winchester” Hard Drive.

Table 3.5.16. 1984–1928–000x 40 Meg Drive Jumpers

Jumper	Setting
A–B	**ON**
C–D	No Jumper
E–F	No Jumper
G–H	No Jumper
J–K	**ON**
DG	No Jumper
PAR	**ON**
A4	**ON**
A2	No Jumper
A1	**ON**

Figure 3.5.5 shows the location and settings for jumpers on the 40 Meg hard disk.

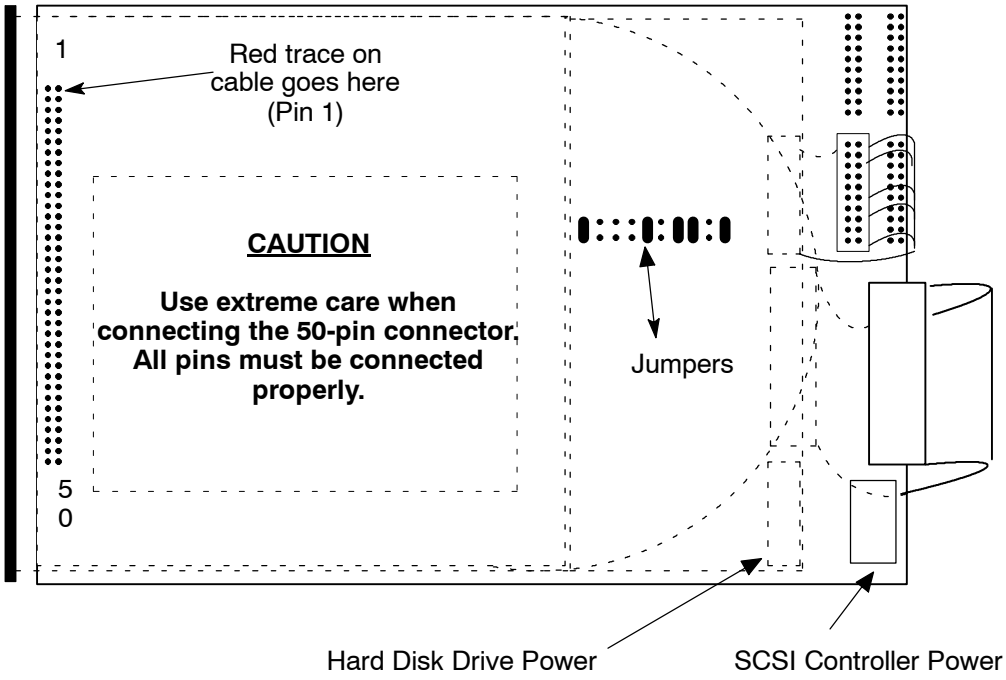


Figure 3.5.5. 1984–1928–000x 40 Meg Hard Drive Jumpers

Floppy Disk Drive

Two sizes of floppy disk drives are used:

- 3.5-inch disk for Multitube Command Console
- 5.25-inch disk for MiniConsole

3.5-Inch Floppy Disk Drive

The 3.5-inch Floppy Disk Drive (1984–2837–000x) is used with the Multitube Command Console. The assembly includes the drive and a SCSI controller board. The SCSI address of the drive is fixed, as is the position of the drive on the SCSI bus. Therefore there is no requirement for address changes or terminators.

The switch on the left side of the drive must be placed in the position nearest to the rear end of the drive unit.

There are two factory set switches on the SCSI board assembly. These must be set as indicated in Table 3.5.17 and Table 3.5.18.

Table 3.5.17. 1984–2837–000x 8-Bit Switch Setting

Switch	Position
1	OFF
2	OFF
3	OFF
4	OFF
5	**ON**
6	**ON**
7	**ON**
8	**ON**

Table 3.5.18. 1984-2837-000x 4-Bit Switch Setting

Switch	Position
1	**ON**
2	**ON**
3	**ON**
4	OFF

The switch settings are shown in Figure 3.5.6

This drive is always used at the same address and position on the SCSI bus. Thus there is no requirement for changing the drive address or bus termination.

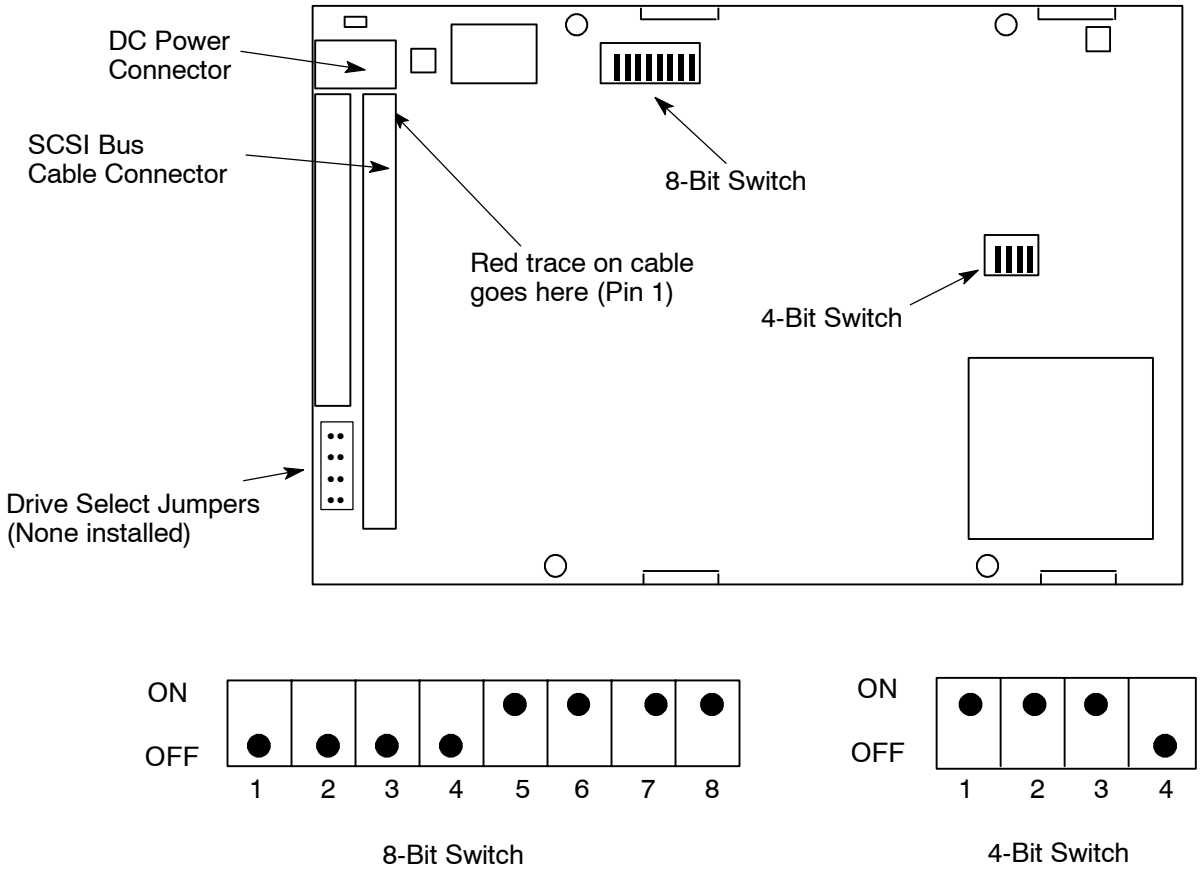


Figure 3.5.6. 1984-2837-000x 3.5-Inch Floppy Disk Drive Dip Switch Positions

5.25-Inch Floppy Disk Drive

The 5.25-inch Floppy Disk Drive (1984–1803–000x) is used with the MiniConsole. Three different drive models have been used:

- Pansonic JU475–4AEG
- Pansonic JU475–3AEG
- Pansonic JU475–2AEG

Jumpering differs for different drive models. See the heading, “MiniConsole 5.25-Inch Floppy Disk Drive Jumpers”, below for details. Table 3.5.19 gives parts replacement data. The replacement kit includes rubber U-channel spacers attached to the bottom of the drive between the mounting holes. These spacers must be in place to give the drive wheel clearance to turn and to insulate the drive from the mounting plate.

Table 3.5.19. 5.25-Inch Floppy Disk Drive Parts Replacement

Part No.	Characteristics
1984–1803–000x	Kit includes drive and mounting hardware

Figure 3.5.7 shows cabling for two floppy disk drives that use the 1984–1754–000x Mini-Floppy Interface Card. The bus terminator (either resistor pack or jumper TM) must be removed from drive 2 in a two drive installation. The terminator must be installed in drive 1 (drive 1 is the last drive on the cable).

The terminator must be installed for a single drive installation.

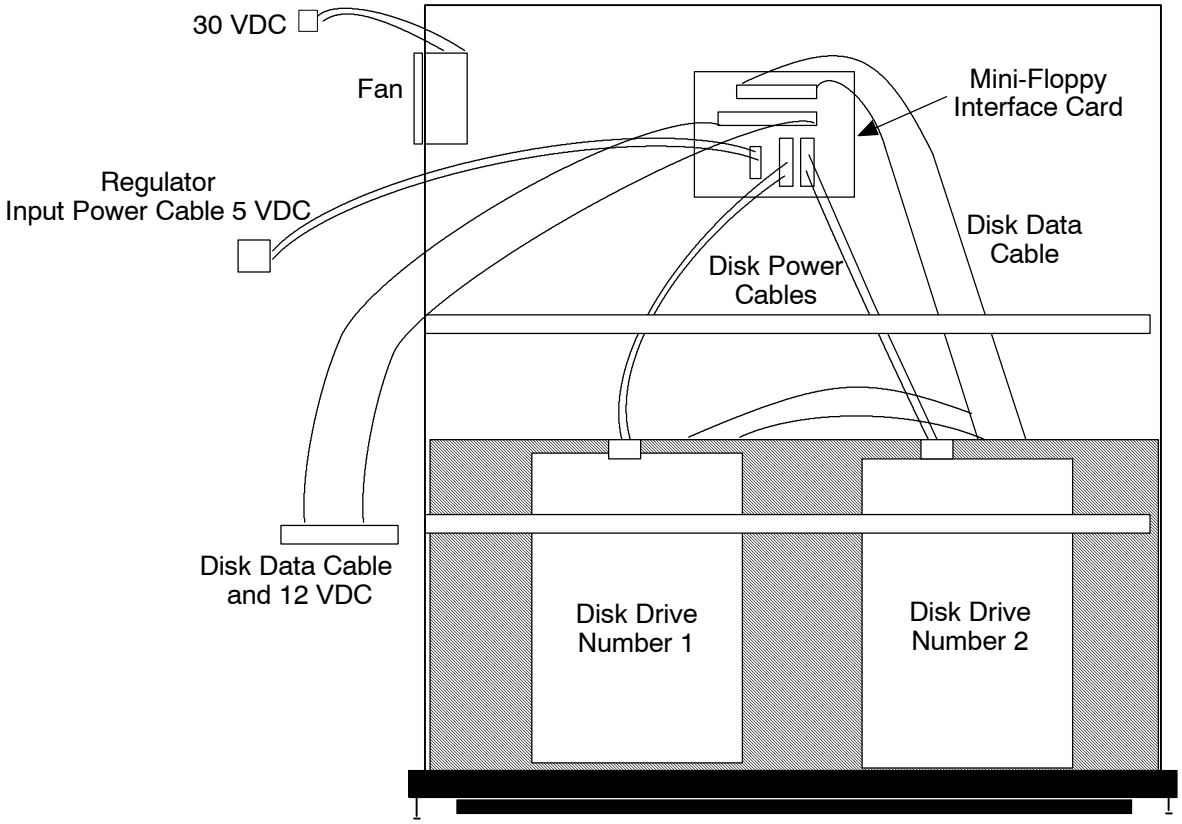


Figure 3.5.7. MiniConsole 5.25-Inch Floppy Disk Drives (Top View)

MiniConsole 5.25-Inch Floppy Disk Drive Jumpers

Jumpering depends on the particular drive model in hand.

Pansonic JU475-4AEG: Figure 3.5.8 shows jumper positions. The drive select jumpers are marked DS1, DS2, DS3, and DS4.

In a two drive installation, the left drive should be jumpered as drive DS1 and the right drive as DS2. Jumper TM must be installed in drive 1 and removed from drive 2.

Jumper TM must be installed for a single drive installation.

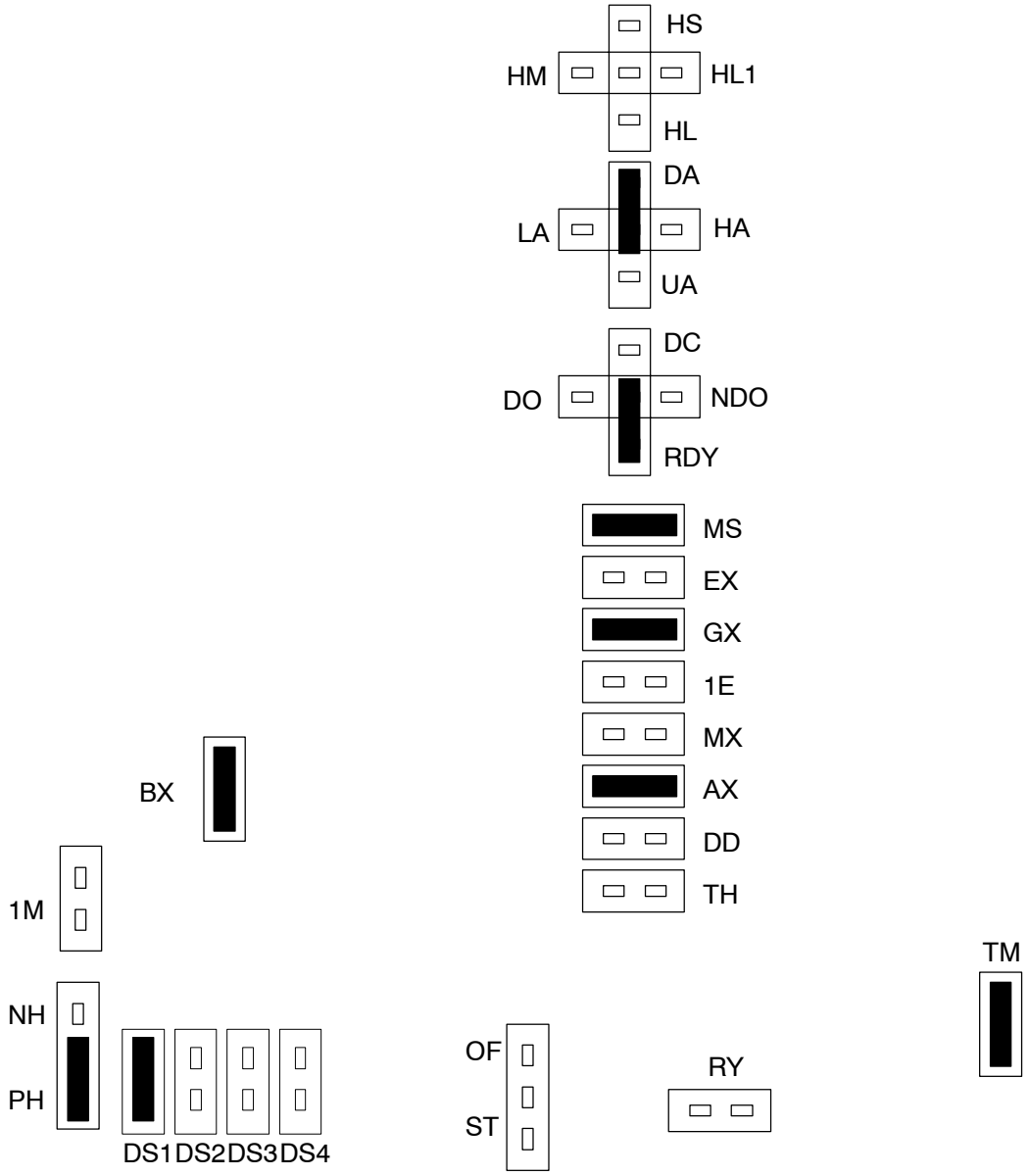


Figure 3.5.8. Pansonic JU475-4AEG 5.25-Inch Floppy Drive Jumper Positions

Pansonic JU475-3AEG: Figure 3.5.9 shows jumper positions. The drive select jumpers are marked 1, 2, 3, and 4.

In a two drive installation, the left drive should be jumpered as drive 1 and the right drive as 2. Jumper TM must be installed in drive 1 and removed from drive 2.

Jumper TM must be installed for a single drive installation.

If the drive shows many checksum errors, try adding a standard RS3 jumper to MDB. This changes the Drive Ready option, which may correct the problem.

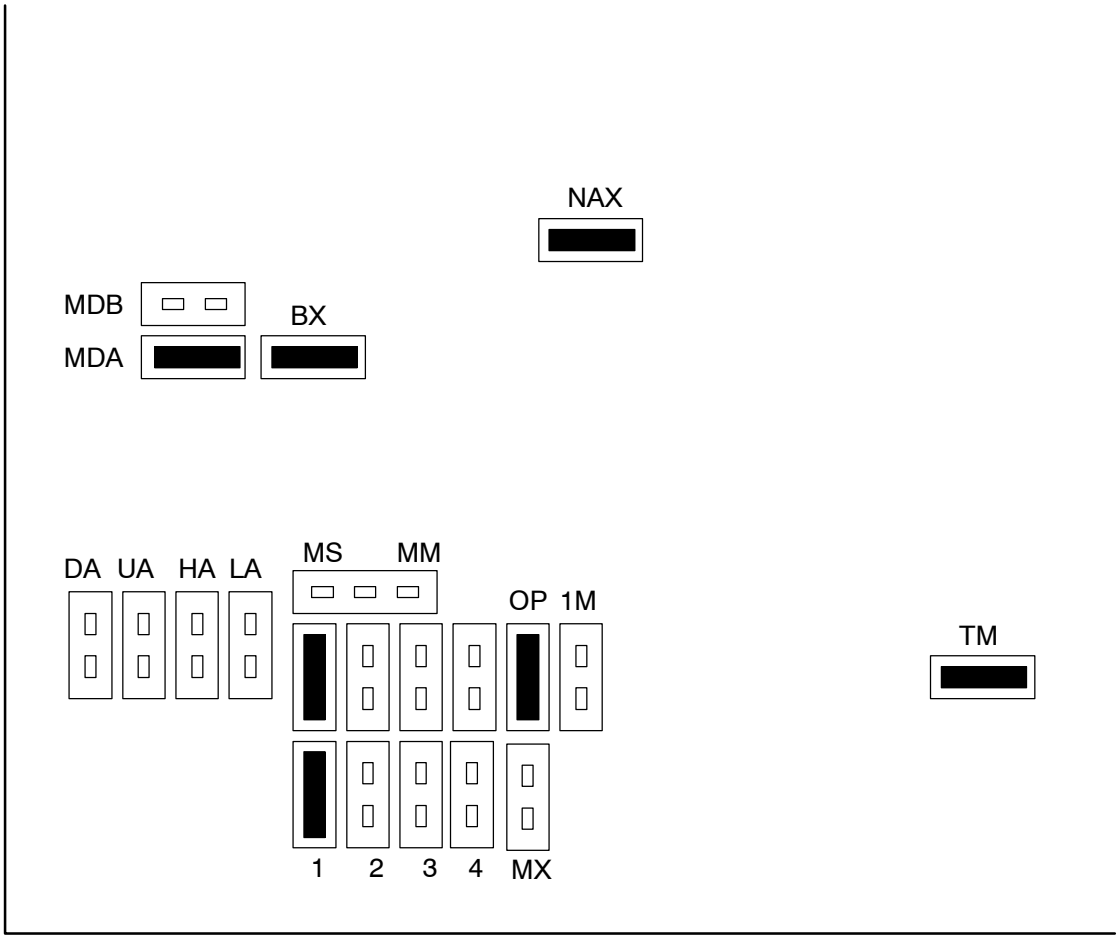


Figure 3.5.9. Pansonic JU475-3AEG 5.25-Inch Floppy Drive Jumper Positions

Pansonic JU475-2AEG: Figure 3.5.10 shows jumper positions. The drive select jumpers are marked 1, 2, 3, and 4.

In a two drive installation, the left drive should be jumpered as drive 1 and the right drive as 2. The resistor pack must be installed in drive 1 and removed from drive 2.

The resistor pack must be installed for a single drive installation.

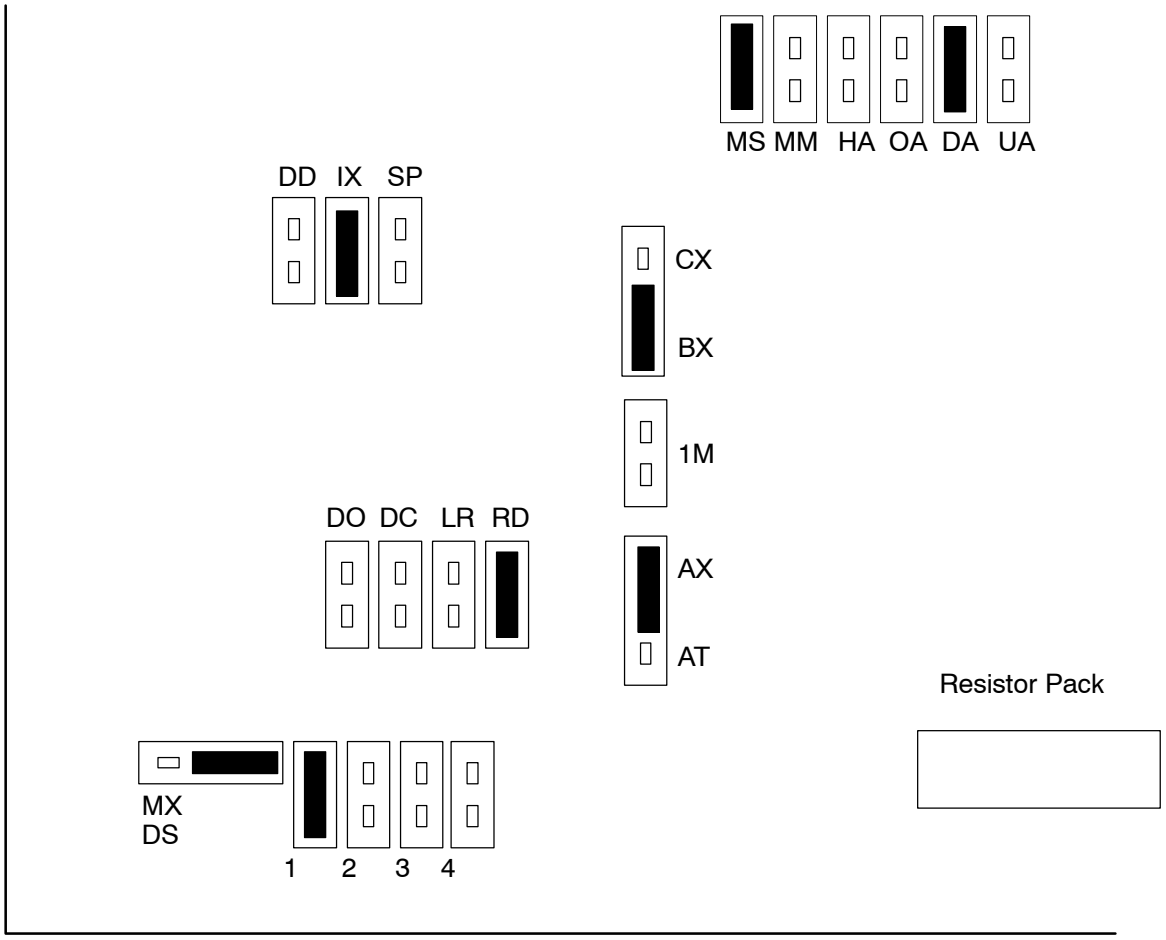


Figure 3.5.10. Pansonic JU475-2AEG 5.25-Inch Floppy Drive Jumper Positions

Magnetic Tape Drive

Magnetic Tape Drives used in the Multitube Command Console and the Pedestal Command Console are:

- 10P5685000x Tandberg 5623
- 1984-3389-000x Viper 2150S
- 1984-3289-000x Viper 2060S
- 1984-1989-000x Scorpion 5945S
- 1984-1927-000x Scorpion 5945C

NOTE: The Viper 2150S and Tandberg 5623 can read tapes written by any of the other drives. None of the other drives can read a tape written by the Viper 2150S or Tandberg because they use a different, higher-density, tape data format. The Viper 2150S, Viper 2060S and Tandberg 5623 require minimum boot ROM and software versions.

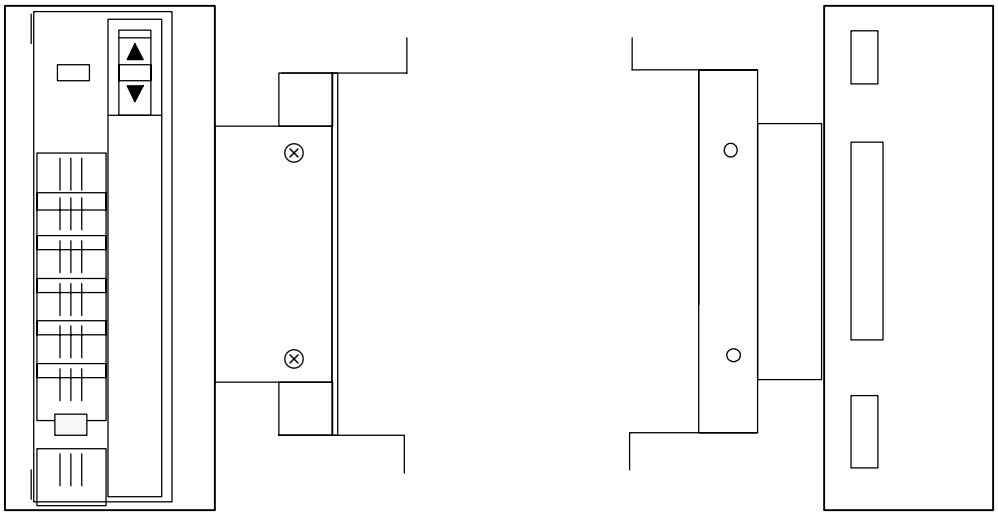
Figure 3.5.11 shows the magnetic tape drive assembly. Table 3.5.20 shows parts replacement data.

CAUTION

Use extreme care when connecting the 50 pin connector. All pins must be connected properly. Also be careful to route cables as they were originally routed.

Table 3.5.20. Magnetic Tape Drive Parts Replacement

Part No.	Replaces	Characteristics
10P5685000x	1984-3389-000x	Tandberg tape drive with embedded SCSI controller. **NOTE:** The Tandberg can read tapes written by any of the drives below. Of the drives listed, only the Viper 2150S can read tapes written by the Tandberg.
1984-3389-000x	1984-3289-000x 1984-1989-000x 1984-1927-000x	Viper 2150S tape drive with embedded SCSI controller. **NOTE:** The Viper 2150S can read tapes written by any of the drives below. The drives below CANNOT read tapes written by the Viper 2150S.
1984-3289-000x	1984-1989-000x 1984-1927-000x	Viper 2060S tape drive with embedded SCSI controller
1984-1989-000x	1984-1927-000x	Scorpion 5945S tape drive with embedded SCSI controller
1984-1927-000x	None	Scorpion 5945C tape drive with SCSI controller board



Tape Drive (Front) Tape Drive (Rear)

Figure 3.5.11. Magnetic Tape Drive

Magnetic Tape Drive Cabling and Grounding

In a Multitube console the magnetic tape drive must connect to one end of the SCSI bus, with the SCSI master O/I card cage 1 (SCSI address 0) in the middle of the bus. The SCSI address is set on the O/I SCSI Host Adapter board (1984-1140-000x).

DC power for the tape drive comes from P981 (P956 on a Pedestal Console). This is the SCSI master O/I card cage DC power cable. The Scorpion 5945C SCSI board is powered from P982 (P955 on a Pedestal Console).

NOTE: Be sure that pin 1 of the SCSI cable matches pin 1 of the tape drive connector.

Magnetic Tape Drive Jumper and Switches

Tandberg 5623 or 9245 Tape Drive: The 10P5685000x magnetic tape drive has a configuration jumper block. The jumpers must be set as indicated in Figure 3.5.12.

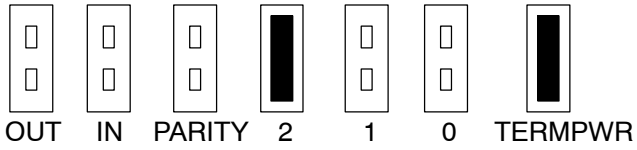


Figure 3.5.12. Tandberg 5623 or 9245 (10P5685000x) Configuration Jumpers

Viper 2150S and 2060S Tape Drive: The 1984-3389-000x and 1984-3289-000x Magnetic Tape Drives have a configuration jumper block. The jumpers must be set as indicated in Figure 3.5.13.

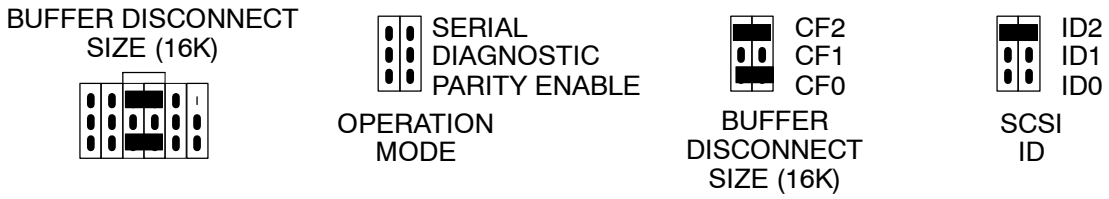


Figure 3.5.13. Viper 2150S (1984-3389-000x) and 2060S Tape Drive (1984-3289-000x) Jumper Block

Scorpion 5945S Tape Drive: The 1984-1989-000x Magnetic Tape Drive has no exposed jumpers or switches. A dip switch, located behind the black front cover, is set for the console tape drive (SCSI address 4). The switch settings should not be changed. Figure 3.5.13 shows the dip switch settings.

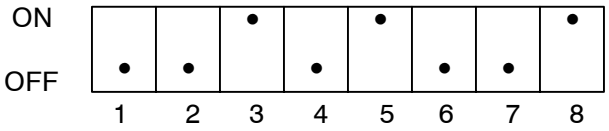


Figure 3.5.14. Scorpion 5945S Tape Drive (1984-1989-000x) Dip Switch Positions

Scorpion 5945C Tape Drive: The 1984-1927-000x Magnetic Tape Drive has an exposed jumper and switch assembly. These should not be changed from the factory settings shown in Figure 3.5.14.

NOTE: The chip at position U2 on the SCSI controller board must be at revision level A08J or higher.

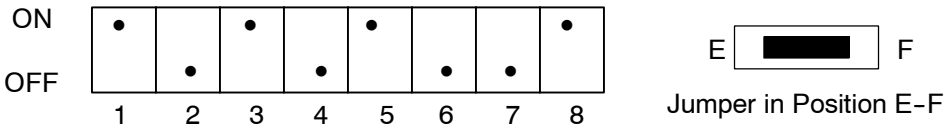


Figure 3.5.15. Scorpion 5945C Tape Drive (1984-1927-000x) Dip Switch Positions

Section 6:
Printers

Several printers are used. This section will cover the following:

- Fujitsu DL3800
- Fujitsu DL4600
- Fujitsu DL2600
- Fujitsu DPL24
- TI 810

Table 3.6.1 gives a cross-reference between the model number (located on the back of the printer) and the printer type.

Table 3.6.1. Printer Types

Model No	Printer Type
M3389A	Fujitsu DL3800
M3367A	Fujitsu DL4600
M3345A	DL2600
M3333C	DPL24

Fujitsu DL3800 Printer

The Fujitsu DL3800 color printer (1984-3318-000x) runs at 300 characters per second (cps) (draft quality), and 100 cps (letter quality). It prints 10 characters per inch and 6 lines per inch. It should be operated at 4800 baud.

The printer dimensions are:

Height	130 mm (5.1 in.)
Width	570 mm (22.4 in.)
Depth	330 mm (13.0 in.)
Weight	8.5 kg (18.7 lb)

For further information see the Fujitsu DL3800 User's Manual (1984-3318-0008) and the Fujitsu DL3800 Maintenance Manual (1984-3318-0011).

The RS-232 serial port is located under a door on the right side of the unit. An internal cable trough is provided to lead the cable to the rear of the unit.

The unit is delivered with the forms tractor in the rear position where it pushes paper that is fed from the rear. The tractor can be moved to the top position where it pulls paper that is fed from the rear or from the bottom. See the User's Manual for the procedure on changing the forms tractor position.

Fujitsu DL3800 Printer Set Up

The set up menu parameters are displayed by printing them out and using the print carriage position to select the desired values. There is a red cursor line on the clear plastic print guide assembly.

❑ **To verify the setup:**

1. Put the printer in setup mode:

   Put the printer off-line (press ONLINE until the ONLINE light goes out). Hold both the FONT and MENU buttons until the printer beeps.

   or

   Turn the printer off. Hold both the FONT and MENU buttons. Turn the printer on. The printer will beep.

2. The printer will print a header describing the setup procedure, a Help menu, and the <<FUNCTION>> menu. The red cursor on the print guide is positioned at the SAVE&END function.

3. Press LOCK to move the cursor to the LIST function. Press FONT to select it. The printer will print the list of options currently in memory.
4. Verify the options against Table 3.6.2 and Table 3.6.3. If any options require changing, use the set up procedure below.

❑ **To set up the Fujitsu DL3800 printer:**

1. Have continuous form paper loaded. The setup procedure will require several sheets.
2. Put the printer in set up mode:

   Put the printer off-line (press ONLINE until the ONLINE light goes out). Press both the FONT and MENU buttons until the printer beeps.

   or

   Turn the printer off. Press both the FONT and MENU buttons. Turn the printer on. The printer will beep.
3. The printer will print a header describing the setup procedure, a Help menu, and the <<FUNCTION>> menu. The red cursor on the print guide is positioned at the SAVE&END function.
4. Press LOCK to move the cursor to the MENU1 function. Press FONT to select it. The printer will print the first item in the menu and the options for the item.
5. The cursor will stop at the option currently stored in memory. This option will have a short underline on the paper. Use LOCK to move the cursor to the desired option.
6. Use FONT to select the option. When an option is selected it is completely underlined. The next item in the menu is then printed.
7. Set MENU1 to the options shown in Table 3.6.2.

Table 3.6.2. Fujitsu DL3800 Printer MENU1 and MENU2 Options

Item	Option	Item	Option
EMULATE	DPL24+	TOP-MRG	1 LINE
FONT	COUR10	LANGUAGE	PAGE 437
QUALITY	DRAFT	CHR-SET	SET 2
PITCH	10 characters per inch (cpi)	PRF-SKP	NO SKIP
LINE SP	6 lines per inch (lpi)	WIDTH	13.6 IN
CHAR-W	NORMAL	ZEROFNT	NO-SLSH
CHAR-H	NORMAL	DC3-CDE	ENABLE
ATTRIB	NONE	CR-CODE	CR ONLY
PAGE LG	11.0 IN	LF-CODE	LF ONLY
COLOR	AUTOSEL	RGHTEND	WRAP
LFT-END	1 COLM		

8. Press ONLINE to return to the <<FUNCTION>> menu. Press LOCK to position the cursor at MENU2. Press FONT to select MENU2. Set the options in MENU2 as shown in Table 3.6.2.
9. Press ONLINE to return to the <<FUNCTION>> menu. Press LOCK to position the cursor at HARDWARE and press FONT to select it. Set the options in the HARDWARE menu as shown in Table 3.6.3.

Table 3.6.3. Fujitsu DL3800 Printer HARDWARE Menu Options

Item	Option	Item	Option
PPR-OUT	CNTONLY	INTRFCE	SERIAL
PRT-DIR	BI-DIR	FORMAT	8NONE1
BUZZER	ON	BAUE-RT	4800
WORD-LG	8 BIT	PROTOCL	XON/XOFF
BUFFER	8KBYTE **NOTE:** Do not use a buffer size larger than 8 kilobytes	DSR	IGNORE
FEEDER	REAR	DUPLEX	FULL

10. Press ONLINE to return to the <<FUNCTION>> menu. Press LOCK to position the cursor at SAVE&END and press LOCK to select it. The configuration will be saved in memory. The printer will be in ONLINE mode, ready for use.
11. The printout serves as a record of the configuration. Selected options have full underlines. Options that were changed have a partial underline at the original value.

Fujitsu DL3800 Printer Self Test

The self test operation prints test pages containing the printer firmware version number, the resident emulations, and all of the characters in the currently selected set. Printing is in seven colors.

❑ **To initiate the Fujitsu DL3800 Printer self test:**

1. Put the printer in setup mode. Select SELF-TST from the <<FUNCTION>> menu.
2. Pause printing by pressing FONT or MENU. Resume with FONT or MENU.
3. Press ONLINE to exit the self test.

Fujitsu DL4600 Printer

The Fujitsu DL4600 color printer (1984-0543-000x) runs at 333 cps (draft quality), and 111 cps (letter quality). It prints 10 characters per inch and 6 lines per inch. It should be operated at 4800 baud.

The printer dimensions are:

Height	190 mm (7.5 in.)
Width	582 mm (22.9 in.)
Depth	386 mm (15.2 in.)
Weight	18 kg (39.7 lb)

Double and triple bin paper handling attachments are available from Fujitsu.

For further information see the Fujitsu DL4600 User Manual (1984-0543-0009) and the Fujitsu DL4600 Maintenance Manual (1984-0543-0008).

Fujitsu DL4600 Printer Set Up

❑ **To set up the Fujitsu DL4600 printer:**

1. Press “NEXT DISPLAY” until “enter setup” appears in the display window. Press F1 so “Menu 1” appears in the display window. Scroll through the options and verify the settings in Table 3.6.4. Scroll with F2. Change options with F3.
2. Press F1 so “Menu 2” appears in the display window. Scroll through the options and verify the settings. Menu 2 must be identical to Menu 1.

Table 3.6.4. Fujitsu DL4600 Printer Setup: Menu 1 and 2

Menu Item	Value	Menu Item	Value
EMULATE	DPL24C	TOP-MRG	1 LINE
FONT	COUR10	LANGUAGE	USA
QUALITY	DRAFT	CHR-SET	SET 2
PITCH	10 CPI	PRT-SKIP	NO-SKIP
LINE SP	6 LPI	WIDTH	13.6 IN
CHAR-W	NORMAL	ZEROFNT	NO-SLASH
CHAR-H	NORMAL	DC3-CDE	ENABLE
ATTRIB	NONE	CR-CODE	CR ONLY
PAGE LG	11.0 IN	LF-CODE	LF ONLY
COLOR	AUTOSEL	RGHTEND	WRAP
LFT-END	1 COLM	=END=	

3. Press F1 until “Hardware Features” appears in the display window. Scroll through the options and verify the settings in Table 3.6.5. Scroll with F2. Change options with F3.

Table 3.6.5. Fujitsu DL 4600 Printer Setup: Hardware Features

Menu Item	Value	Menu Item	Value
SensePE	REAR	FORMAT	8 NONE 1
PRT-DIR	BI-DIR	BAUD-RT	4800
BUZZER	ON	PROTOCOL	XON/XOFF
WORD-LG	8 BIT	DSR	IGNORE
BUFFER	8 KBYTE **NOTE:** Do not use a buffer size larger than 8 kilobytes	DUPLEX	FULL
FEEDER	REAR	=END=	
INTRFCE	SERIAL		

4. Press F1 until “Save” appears in the display window. Press F3 to save the configuration.
5. Press F1 until “Func LIST” appears. Press F3 to print the option lists. Verify the printed lists.
6. Press F1 until “Self Test” appears in the display window. Press F3 to start the test and press F2 to stop it after about 30 seconds. Press F1 to exit the self test.
7. Press the “ON LINE” button to resume normal operation.

Fujitsu DL2600 Printer

The Fujitsu DL2600 color printer (1984-0533-000x) runs at 288 cps (draft quality), 96 characters per second (letter quality), and 8 inches per second (graphics). It prints 10 characters per inch and 6 lines per inch. It should be operated at 4800 Baud.

See the Fujitsu Maintenance Manual (1984-0533-0021) for troubleshooting procedures and the User Manual (1984-0533-0022) for user information.

Figure 3.6.1 shows the Fujitsu DL2600 printer Control Panel. Each key has three legends: one above the key, one on the key, and one below the key. Keys will be specified using the label appropriate for the action being performed.

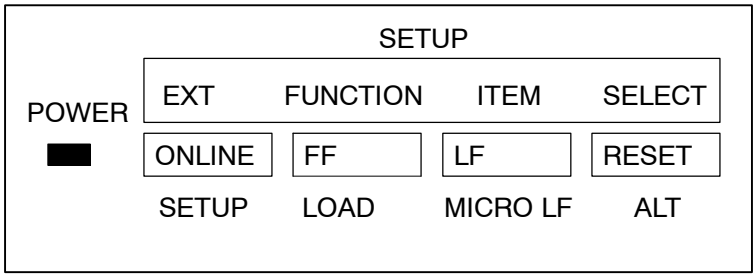


Figure 3.6.1. Fujitsu DL2600 Printer Control Panel

Fujitsu DL2600 Printer Error Messages

There are four types of error messages that may be displayed on the printer control panel:

1. Operational
2. Paper handling
3. Serial interface
4. Memory

Fujitsu DL2600 Printer Paper Handling

❑ **To load the paper:**

1. Pull the paper release lever towards the front of the printer.
2. Pull the paper bail lever toward the front of the printer.
3. Hold the ALT key and press LOAD.
4. Return the paper bail lever to the former position.

❑ **To adjust for paper thickness:**

1. Set the paper thickness adjustment lever, located on the right side under the front cover, as indicated in Table 3.6.6.

If the lever is set too low, the paper may be damaged at the edges, line feeding may be off, or the ribbon may come loose.

If the lever is set too high, the printing may be light or characters may be missing.

Table 3.6.6. Fujitsu DL2600 Printer Paper Thickness

Paper	Notch
Single part, 10 pound	1 or 2
Two part	2
Three part	3
Four part	4
Ribbon removal	D

Fujitsu DL2600 Printer Set Up

❑ **To set up the Fujitsu DL2600 printer:**

1. Hold down ALT and then press SETUP. The display shows “SET-UP MODE” and then “FUNCTION: STYLE”.
2. Press ITEM to enter the “style” level.
3. Press SELECT to display each of the items listed in Table 3.6.7. When the correct item is displayed, press ITEM to enter it in memory.

Table 3.6.7. Fujitsu DL2600 Printer Setup

Item	Value	Item	Value
EMULATE:	DPL24C	PAGE LG:	11.0 IN *
CHR SET:	SET 2 *	TOP MRG:	1 LINE *
LANGUAGE:	USA *	DC3-CDE:	ENABLE
GRPH LF:	IBM GRH *	AUTO CR:	NO
LFT END:	1 COLM *	FONT:	COUR10 *
PPR OUT:	DETECT *	COLOR:	AUTOSEL *
LF-CODE:	LF ONLY	LINE SP:	6 LPI *
BUZZER:	ON *	PRF SKP:	NO *
QUALITY:	DRAFT	OFFSET:	0 *
ATTRIB:	NONE *	CR-CODE:	CR ONLY *
CHAR SP:	10 CPI *	PRT-DIR:	BI-DIR *

* indicates a factory setting

4. Press FUNCTION until “FUNCTION: INTERFACE” is displayed. Press ITEM to enter the “function” level.

5. Press SELECT to display each of the items listed in Table 3.6.8. When the correct item is displayed, press ITEM to enter it in memory.

Table 3.6.8. Fujitsu DL2600 Printer Setup

Item	Value	Item	Value
TYPE:	SERIAL	PROTOCL:	XON/XOFF
WORD LG:	8 BIT	DUPLEX:	FULL
FORMAT:	8NONE 1	CONTROL:	3 WIRE
BAUD RT:	4800		

6. Press FUNCTION until “FUNCTION SAVE” is displayed. Press ITEM to have the printer save the selected options in nonvolatile memory.
7. Press ONLINE to resume normal operation.

Fujitsu DL2600 Printer Self Test

During the printer self test the following items are printed:

- The current setups
- The firmware revision level
- A series of complete character sets in alternating colors at the maximum paper width.

❑ **To initiate the Fujitsu DL2600 printer self test:**

Either

1. Turn the power off. Hold the FUNCTION key down and turn the power on.

or

2. a. Hold down ALT and press SETUP.
   b. Press FUNCTION until “FUNCTION: SELF TEST” is displayed.
   c. Press SELECT or ITEM to start the test.

❑ **To pause the test:**

1. Press either ALT or SETUP. To resume, press the same button again.

❑ **To stop the test:**

Either

1. Turn the power off and then on.

or

2. Press FUNCTION.

Vertical alignment is set at the factory and should not require field adjustment. However, if the alignment is off, use the following procedure.

❑ **To adjust Fujitsu DL2600 printer vertical alignment:**

1. Load full width paper.
2. Turn the power off. Hold FF and LF and turn the power on. The display reads “VER:ALIGNMENT:0”. The printer prints a series of vertical lines.
3. If the lines are not aligned, press LF or FF until they are aligned. The display may range from –7 to +8.
4. When the lines are aligned, press RESET. The display will read “SAVING NOW!” and the alignment will be saved.

Fujitsu DL2600 Printer Functional Test

The functional test checks almost all printer features. First verify the operator interface setup and then run the functional test.

NOTE: For software Version 11, verify that “PRINTER” is set to “FUJITSU”.

❑ **To run the functional test from a Command console:**

1. Type CCC [ENTER] at the home position to display the “Configure Command Console” screen. Cursor to the printer entry area and verify that these settings are valid:

BAUD:	4800
FI	YES
L/PG	66
GRAPHICS	YES

❑ **To run the functional test from a MiniConsole:**

1. Type CM [ENTER] to display the “Configure Minicon” screen. Cursor to the printer entry area and verify that these settings are valid:

BAUD:	4800
FI	YES
L/PG	66

❑ **To perform a Fujitsu DL2600 printer functional test:**

1. Take the printer off-line by pressing ONLINE. Press LF. The paper should advance one line. Hold LF. The paper should advance continuously.
2. Press FF. The paper should advance to the head of form.
3. Move the paper bail to the released position. Press RESET and FF together. The paper should unload. Pressing RESET and FF together should cause the paper to reload.
4. Press RESET and FF together. Release them and press LF. The paper should advance in a microstep for each depression of LF.
5. Return the printer to online status by pressing ONLINE.
6. Operate the printer from the system console.

Fujitsu DL2600 Printer Operation

❑ **To operate the printer from a Command Console:**

1. Place the cursor at home. Type [C] [C] [P] [ENTER] or use [NEXT OPTION] to scroll through options to “CONFIG COLOR PALETTE”. Press [ENTER].
2. With the cursor at home, type [S] [G] and [ENTER]. The printer should print the “CONFIG COLOR PALETTE” screen.
3. Verify that the printed output is in color, that all characters are visible, and that the paper advanced one page.

❑ **To operate the printer from a MiniConsole:**

1. Select the main menu screen by typing [M] [M] [ENTER]. Press [PRINT].
2. Press [PRINT]. The printer should print the main menu screen.
3. Verify that the printout has all characters visible, and that the paper advanced one page.

Fujitsu DPL24C Printer

The Fujitsu DPL24C color printer (1984-0510-000x) has graphics resolution of .001 x .001 inch with an 8-bit image mode. It prints at 240 characters per second (cps) (draft quality) and 80 cps (letter quality). Character spacing is 10 characters per inch, 136 characters per line. Line spacing is 6 lines per inch. See the Fujitsu DPL24C User Manual (1984-0510-0022) for user details. See the Fujitsu DPL24C Maintenance Manual (1984-0510-0021) for hardware details.

Fujitsu DPL24C Printer Switch Settings

The printer should be set to operate at 4800 Baud and 6 lines per inch. Table 3.6.9 shows the settings of the dip switches on the Printer Control Panel. “Don’t care” indicates switches that can be in either position.

Table 3.6.9. Fujitsu DPL24C Printer Switch Settings

Dip Switch	1	2	3	4	5	6	7	8
A	**ON**	OFF	**ON**	OFF	OFF	OFF	OFF	**ON**
B	**ON**	**ON**	OFF	OFF	OFF	OFF	OFF	OFF
C	OFF	OFF	OFF	OFF	OFF	OFF	(Don’t care)	(Don’t care)
D	**ON**	**ON**	**ON**	**ON**	OFF	**ON**	OFF	OFF

The Form Length switches should be set to 66 for 27.9 cm (U.S. 11-inch) paper and to 72 for 30.5 cm (12-inch) paper.

NOTE: New switch settings will take effect after printer power has been cycled or the Reset button is pressed.

Fujitsu DPL24C Printer Self Test

The self test prints the character set for each type style and each language, followed by a vertical line in each column. There are eight type styles and eight languages on the standard printer.

❑ **To initiate the printer self test:**

1. Turn the power off.
2. Hold the self test (FF) switch down.
3. Turn the power on. The self test will begin.
4. Release the self test switch.
5. The self test will stop if:
    a. The reset button is pressed.
    b. The power is turned off
    c. The top cover is opened
    d. The printer runs out of paper.

Fujitsu DPL24C Printer Vertical Alignment

The Adjust switch is used to adjust the vertical alignment of the print columns. Due to mechanical inaccuracies of the carriage movement across the paper, an electrical adjustment is used to ensure that a character will print in exactly the same spot whether the printhead is moving left or right.

The vertical alignment is factory set and should not require field adjustment. It can be modified by this procedure:

❑ **To check and modify the vertical alignment:**

1. Initiate the printer self-test. When all character sets have been printed, a vertical line will be printed in each column.
2. Observe the vertical alignment and make adjustments as required with the Adjust switch.
3. Stop the self test by pressing the reset button, turning off the power, or opening the top cover.

Fujitsu DPL24C Printer Error Signals

The error lamp lights and the buzzer sounds if the printer detects a communications problem or a circuit malfunction.

1. Communications Error

   A “?” is substituted for any character received with an error.

2. Circuit Malfunction

   Refer to the Fujitsu DPL24C Printer Maintenance Manual (1984-0510-0021), for troubleshooting procedures.

Fujitsu DPL24C Printer Paper Handling

The printer functions best with 20 pound, standard perforation paper. Micro perforation paper will often burst the perforations before the paper feeds through the printer, causing paper jams. Standard perforation paper of 15 pound weight should not be used. This paper lacks the body to reliably feed through the printer tractor mechanism.

The paper thickness lever adjusts the spacing between the printhead and the platen to compensate for various paper thickness. It is located at the extreme right side, under the printer cover. It is marked from 1 to 9. Each graduation moves the printhead about .05 mm (.002 in.). One graduation corresponds roughly to one sheet of paper.

NOTE: The lever should NOT be set to “1” for one thickness of paper. Follow the procedure below to adjust the paper thickness level properly.

If the lever is set too low:

- Paper may be damaged at the left and right margins.
- Printing may smear as the paper is advanced.
- Line feeding may be inaccurate.
- The ribbon may come off of the guides or come loose during printing.

If the setting is too high:

- Printing may be light and/or characters may be missing.

❑ **To adjust the paper thickness lever:**

1. Move the lever to position 9 to move the printhead as far as possible from the platen.
2. Initiate the self test. Move the lever to a lower number until the print quality is as desired.
3. Stop the self test by pressing the reset button or turning off the power.

Paper jams may be caused by:

- Poor paper quality or improper thickness.
- Improper adjustment of the paper thickness lever.
- Scraps of paper in the feed path.
- Misalignment of the box of paper that is feeding the printer. The box should sit directly beneath the printer infeed slot.
- Improper alignment of the paper catch basket.

❑ **To clear a paper jam:**

1. Turn off the power and open the front cover.
2. Note the setting of the paper thickness lever. Set the lever to 9 to give the maximum clearance between printhead and platen.
3. Place the printhead at either end of the line.
4. Carefully pull the jammed paper out of the printer. Rotate the platen knob to remove all scraps from beneath the platen.
5. Center the printhead and insert paper into the form tractors. Rotate the platen knob to feed the paper.
6. If the paper does not feed freely, use 4 or 5 sheets of paper (folded together) to push out any scraps remaining in the paper path.
7. When the paper feeds normally, return the paper release lever to the original setting and close the front cover. Turn the power on and operate.
8. If this does not clear the jam, remove the platen to access the feed mechanism. See the Fujitsu Maintenance Manual (1984-0510-0021), for the platen removal procedure.

TI 810 Printer

The Texas Instruments 810 (1984-0317-000x) is a basic printer. See the Operator Manual (1984-0317-0005) for details.

TI 810 Printer Jumpers and Switches

Jumpers on the TI 810 Processor Board are set as shown in Table 3.6.10.

Table 3.6.10. TI 810 Processor Board Jumpers

Jumpers	Setting
E1-E2-E3	E2-E3
E4-E5-E6	E5-E6
E7-E8-E9	E8-E9
E10-E11-E12	E11-E12
E13-E14-E15	E13-E14
E16-E17-E18	E17-E18
E19-E20-E21	OPEN
E22-E23-E24	OPEN

Jumpers on the TI 810 Motherboard are set as shown in Table 3.6.11.

Table 3.6.11. TI 810 Printer Motherboard Jumpers

Jumpers	Setting
E1-E2	JUMPERED
E3-E4	JUMPERED
E11-E12-E13	E11-E12

The seven dip switches (pencil switches) located under the access door are set as shown in Table 3.6.12. This sets the printer up for:

- 4800 Baud
- No Parity
- No Automatic Linefeed
- No Automatic Top of Form.

NOTE: Printer power must be cycled on and off after you change any switches.

Table 3.6.12. T1 810 Printer Baud Rate (Pencil) Switches

Switch	Setting	Switch	Setting
1	ON	5	OFF
2	OFF	6	ON
3	ON	7	ON
4	OFF		

TI 810 Printer Voltage Checks

The test points and proper voltages are listed in Table 3.6.13.

Table 3.6.13. TI 810 Printer Voltage Checks

Test Point	Voltage	Tolerance
E4	+ 12 VDC	± .6 VDC
E5	– 12 VDC	± .6 VDC
E6	+ 8 VDC	± 1 VDC
E7	– 75 VDC	± 15 VDC
E8	– 5 VDC	± .25 VDC
E9	+30 VDC	± 10 VDC
E10	+ 5 VDC	± .05 VDC

TI 810 Printer Modification for 30.5 Cm Paper

The TI 810 Printer is designed to work with standard U.S. paper which is 11 inches long. It can be modified to use standard European 30.5 cm (12-inch) paper with the following procedure.

NOTE: A special jumper wire is required. Order it from your normal FRSI parts source.

❑ **To modify the TI 810 Printer for 30.5 cm paper:**

1. Turn the power off.
2. Remove the plastic paper cover and the access door.
3. Remove the five screws that hold the cover down: three in front and two in back.
4. Locate connector J7 (it may be marked as J16 on the motherboard), which is just behind and to the left of the paper drive motor. The cable connects the motherboard to the Auxiliary Control Panel.
5. Pull the cable off of the motherboard pins.
6. Insert the special jumper wire into the cable connector, as shown in Figure 3.6.2.
7. Reinsert the cable connector on the motherboard pins.
8. Replace the cover, paper cover, and access door. Turn the power on.

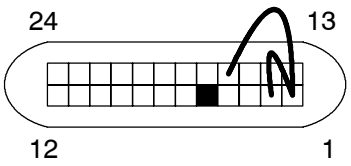


Figure 3.6.2. TI 810 Jumper Wire

TI 810 Printer Modification for Lowercase Printing

The TI 810 printer can be modified to print lowercase characters while connected to the system. The modification does not affect operation of the printer with VDS-25 systems.

A ROM (TI part number 1166–0505–0021) must be inserted at U67 (located at the top left hand side of the Printer Processor Board). The part may be obtained from Texas Instruments.

TI 810 Printer Printing Half Page of Data

If only about half a page is printed at a time, check to be sure that “DNB” is enabled on the Printer Processor Board. This “Data Terminal Not Busy” enables the terminal buffer control to stop data transfer from the console until the buffer is empty and ready for more data. TI service personnel may change the jumper or replace the Printer Processor Board with the jumper in the wrong location for operation with RS3.

❑ **To enable DNB:**

1. Set jumpers E4-E5-E6 to E5-E6.

Section 7:
OI Card Cage

This section covers the OI (Operator Interface) Card Cage (also called the Console Card Cage). The major components covered in this section are the:

- Electronics Cabinet
- Alarm Output Panel
- OI Card Cage
- PeerWay Interface
- Power Regulator
- OI Processor
- Video Generator (Character Graphics)
- Video Generator (Pixel Graphics)
- Printer Interface
- Small Computer System Interface (SCSI)
- OI Nonvolatile Memory
  - Bubble
  - RAM

The OI Card Cage is used with the:

- Multitube Command Console (MTCC)
- System Manager Station (SMS)
- Command Console (CC)
- Basic Command Console (BCC)
- Hardened Command Console (HCC)
- System Resource Unit (SRU)
- Supervisory Computer Interface (SCI)
- Highway Interface Adapter (HIA)
- Diogenes Interface

The operator interface portions of the console (keyboard, CRT, tape drive, and floppy disk drive) are covered in earlier sections of this chapter.

Maintenance and troubleshooting are covered in chapters 9 and 10.

Electronics Cabinet

The Electronics Cabinet houses one or more OI Card Cages, disks, and tape drives. The “Tower” and System Manager Station (SMS) versions house a single OI Card Cage. The standard version houses up to three OI Card Cages and power supplies. Figure 3.7.1 and Figure 3.7.2 show the front and rear view of a standard Electronics Cabinet. Configurations vary.

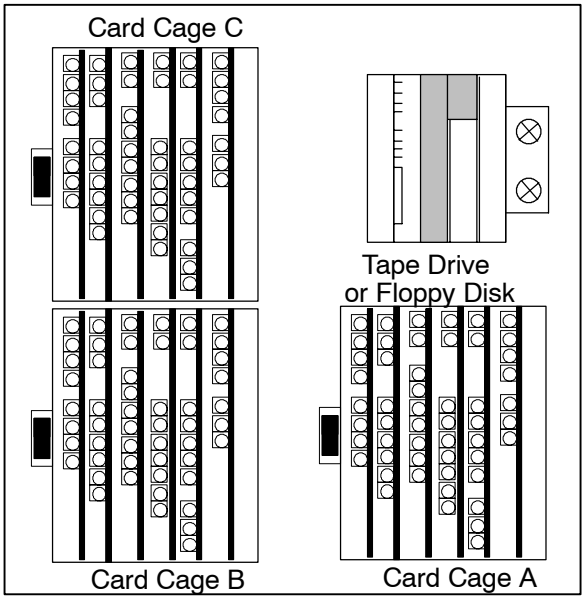


Figure 3.7.1. Standard Electronics Cabinet (Front View)

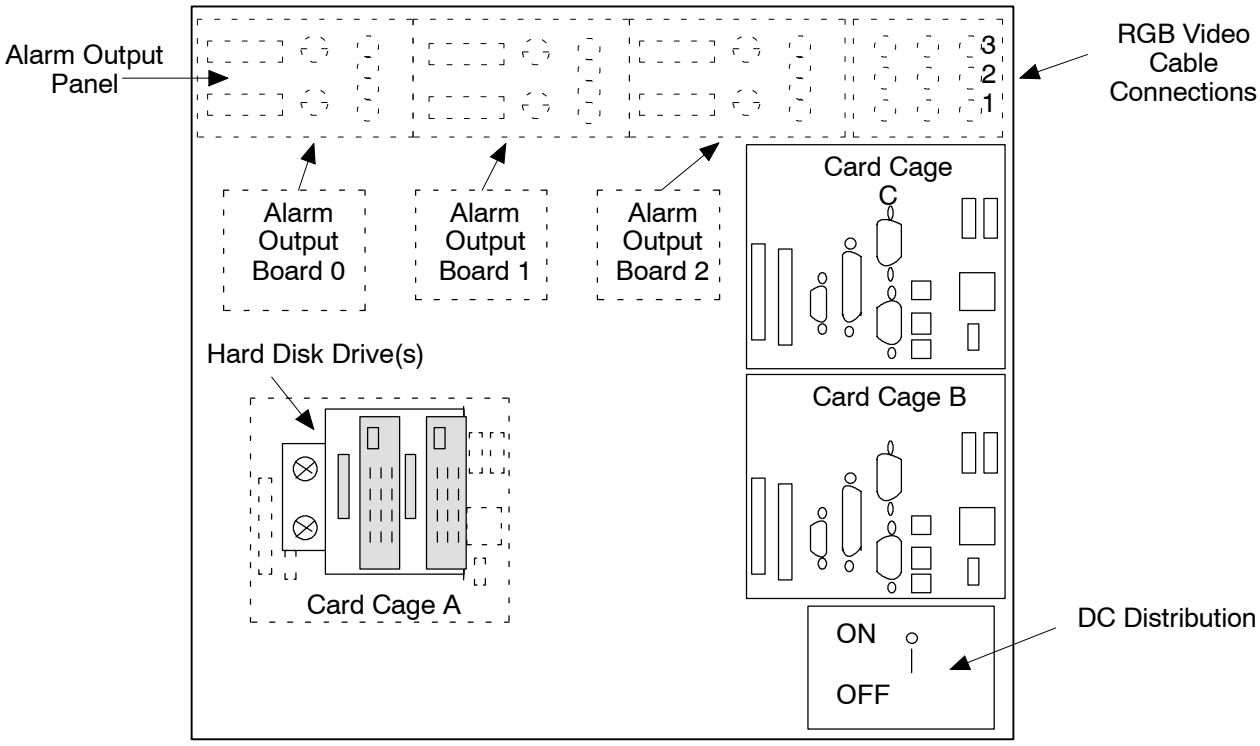
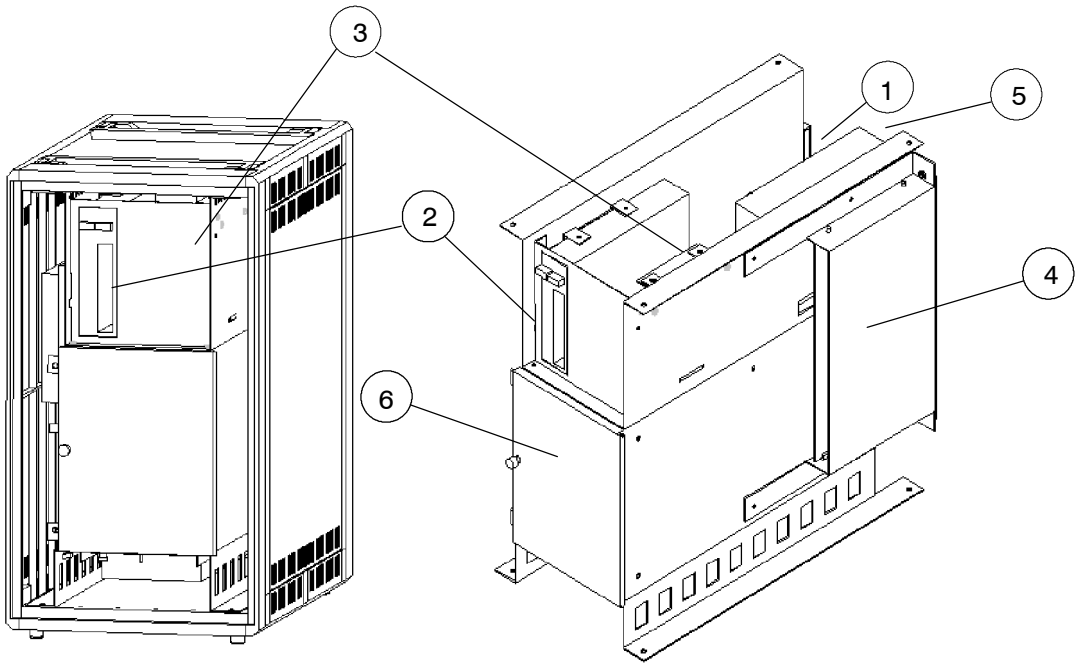


Figure 3.7.2. Standard (non-EMC) Electronics Cabinet (Rear View)

System Manager Station

The System Manager Station is a stand-alone, upright arrangement of the RS3 Operator Interface Console. The System Manager Station (SMS) is EMC-compliant. The SMS is shown in Figure 3.7.3.



Front Door Removed **Panels Removed**

No.	Description	No.	Description
1	PeerWay Tap	4	Keyboard/Video Interface (if internal mount)
2	Tape Drive	5	Power Supply (if present)
3	Disk Drive	6	OI Card Cage (door closed)

Figure 3.7.3. System Manager Station

Alarm Output Panel

The Alarm Output Panel supports up to three Alarm Output Boards and has an optional marshaling panel for up to three sets of RGB (red, green, blue) video cables between OI Card Cages and CRTs. Figure 3.7.4 shows the Alarm Output Panel.

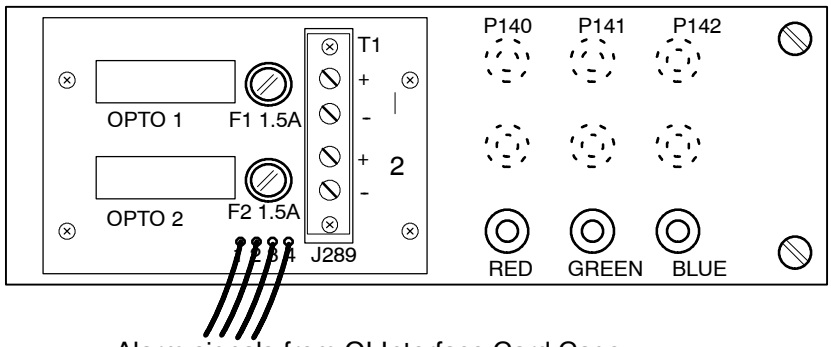


Figure 3.7.4. Alarm Output Panel

NOTE: The Alarm Output Panel is optional with the 10P52820001 OI Card Cage.

Alarm Output Board

The 1984-0744-0005 Alarm Output Board mounts on the Alarm Output Panel. It is connected to the OI Card Cage alarm outputs and has optical isolation for two sets of alarm contacts. Figure 3.7.5 shows wiring for the Alarm Output Board.

The optically isolated alarm circuits are rated for 5-40 VDC and up to 1 Amp. The alarm contacts are fused as shown in Table 3.7.1.

CAUTION

Do not power the alarm circuit with AC. Use of AC and AC rated optical isolators can result in problems that are very hard to locate.

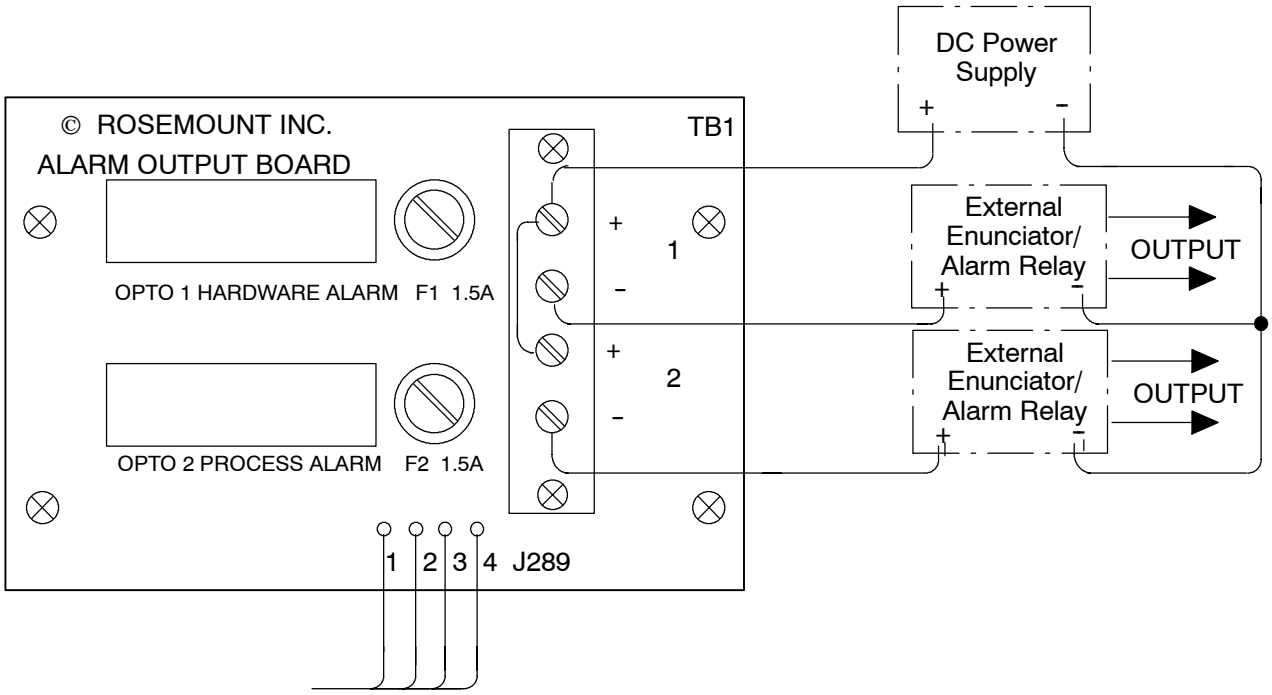


Figure 3.7.5. Alarm Output Board Wiring

Table 3.7.1. Alarm Output Board Fuses

Fuse	FRSI Part No.	Bussman Part No.	Characteristics
F1 F2	G09140–0029	MDQ–1-1/2	1.5 A 250 V Slow Blow

OI Card Cage

The OI (Operator Interface) Card Cage is also called the Console Card Cage. Figure 3.7.6 shows the front of the OI Card Cage. Table 3.7.2 shows parts replacement data.

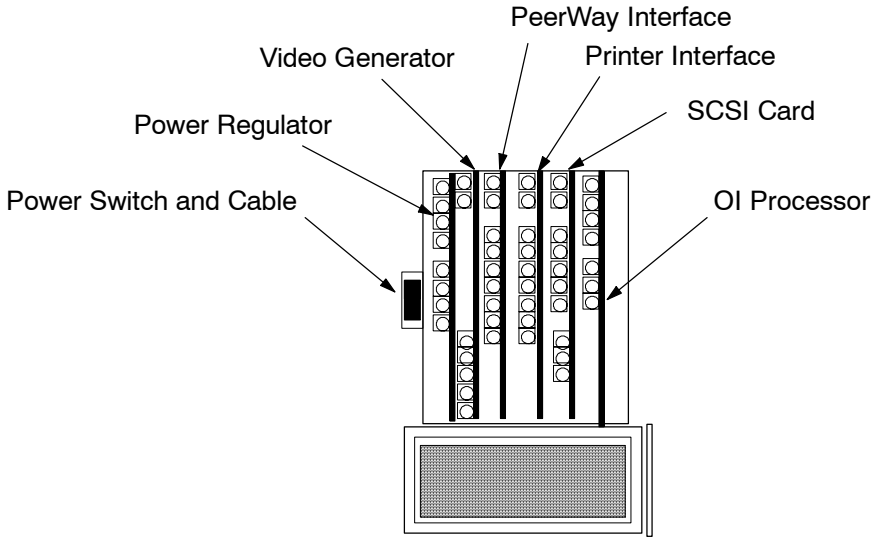


Figure 3.7.6. OI Card Cage (Front)

These versions are available:

- OI Card Cage (EMC-compliant) 10P52820001
- OI Card Cage 1984-0660-000x

Table 3.7.2. OI Card Cage Parts Replacement

Part Number	Replaces	Comments
10P52820001	1984-0660-000X	All installations except MiniConsole, Enhanced Command Console (ECC), and BCC. Supports single tube only.
1984-0660-000X	10P52820001	Only where EMC-compliance is not a requirement.

The OI Card Cage motherboard is the central signal distribution point for all console lines. There are no active components or fuses on the motherboard.

The following are routed through the motherboard:

- DC distribution bus
- DC power switch
- Dual PeerWay interface
- Fan
- CRT screen
- Keyboards
- Printer
- Magnetic storage media (floppy disk or hard disk and tape)
- Power Regulator
- Video Generator
- PeerWay Interface
- Printer Interface
- Nonvolatile Memory
- Disk Drive or SCSI Interface
- OI Processor

Circuit card components face to the left. The bottom 20 pins (component and solder side) are assigned individual functions according to the card slot. Pin numbering begins at the bottom and goes up. Because of this, cards are not interchangeable and are keyed to prevent incorrect slot insertion. Pins 21 through 60 (solder and component side) are common across the bus. They are:

- +30 V A and B
- 30 V return
- +5
- +5 return
- +12 V
- +12 V return
- Isolated 9 V A and B
- Isolated 9 V return lines
- Address bus (A0 through A15)
- Data bus (D0 through D16)
- Control bus
  - Interrupt 1 through 6
  - Data Transfer Acknowledge (DTACK)
  - Upper and Lower Data Strobe
  - Read/Write
  - System Clock
  - Reset

OI Card Cage 10P52820001

The EMC-compliant OI Card Cage is built in a shielded enclosure with a door in front and a special filterboard (10P50450001) at the rear. Figure 3.7.7 shows the connectors and fuses on the rear of the OI Card Cage. Table 3.7.3 lists the OI Card Cage connectors and fuses.

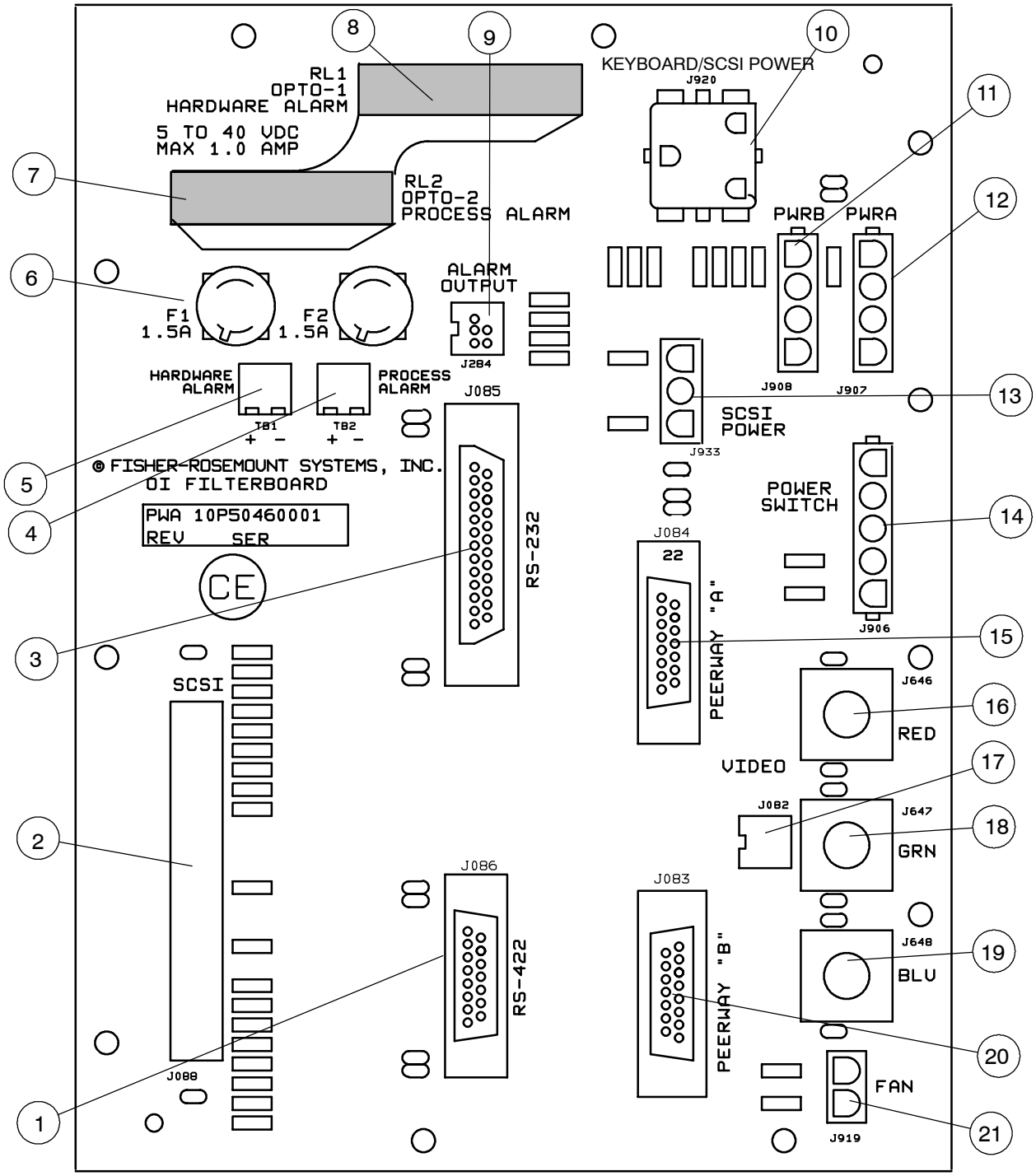


Figure 3.7.7. Rear View of EMC OI Card Cage 10P52820001

Table 3.7.3. EMC OI Card Cage 10P52820001 Connectors and Fuses

No.	Description	No.	Description
1	RS-422 Keyboard Interface cable connection (J086)	12	DC power A cable connection (J907)
2	SCSI cable (J088)	13	SCSI power cable connection (J933)
3	RS-232 printer cable connection (J085)	14	Power Switch cable connection (J906)
4	Process Alarm cable connection (TB2)	15	PeerWay A Drop Cable connection (J084)
5	Hardware Alarm cable connection (TB1)	16	Video BNC Output RED (J646)
6	Alarm Circuit fuses (F1, F2) 1.5 A max	17	Video Output cable connection to the BNC Breakout Panel (replacement use only) (J082)
7	Process Alarm Opto-2 (RL2)	18	Video BNC Output GRN (J647)
8	Hardware Alarm Opto-1 (RL1)	19	Video BNC Output BLU (J648)
9	Alarm Output cable connection to Alarm Output Panel (replacement use only) (J284)	20	PeerWay B Drop Cable connection (J083)
10	Keyboard/SCSI power cable connection (J920)	21	Fan cable connection (J919)
11	DC power B cable connection (optional) (J908)		

NOTE: The Alarm Output Panel is optional with the 10P52820001 OI Card Cage.

Follow these rules to ensure EMC (CE) compliance:

1. Use cables listed in Table 3.7.4, as required.
2. The Keyboard/Video Interface-to-CRT coaxial cable (1984-1691-0003) is approximately 1 meter (39 in.) long. Do not use a longer cable between the KVI and the CRT.
3. Use Keyboard/Video Interface 10P50840004 or 2004.
4. Use keyboards, trackball, printer, and CRT bearing the CE mark and install them in a control room environment.
5. Power the cage from a CE-approved power supply such as the system DC bus or a MARK I Remote Power Supply (10P5409000x).
6. The door at the front of the OI Card Cage must be closed for the unit to meet EMC specifications.

Table 3.7.4. CE-Compliant Cables

Cable	Part Number	Maximum Length
PeerWay Drop Cable	1984-0473-00xx	15.2 meters (50 feet)
DC Power Cable, bus to product	1984-0158-0xxx	61 meters (200 feet)
DC Power Cable, remote power supply to product	1984-1083-00xx	15.2 meters (50 feet)
DC Power Cable, local power supply to product	10P54100001	Standard
Fan Power Cable (for use with remote power supply)	1984-1605-0009	Standard
Fan Power “Y” Cable (for use with local power supply)	10P54190001	Standard
Power Cable, disk and tape drive	10P56840001	Standard
I/O Cable, disk and tape drive	1984-1895-9901	Standard
Keyboard/Video Interface (KVI) Power Cable	1984-1628-0xxx	152.4 meters (500 feet)
RGB Video Cable, coaxial, console to KVI	1984-1691-0xxx	152.4 meters (500 feet)
RGB Video Cable, shielded, KVI to CRT	1984-1691-0003	1 meters (3 feet)
KVI Communication Cable, shielded, OI Card Cage to KVI	10P52890xxx	152.4 meters (500 feet)
Printer Communication Cable, shielded	10P530800xx	15.2 meters (50 feet)

The filterboard includes both Alarm Panel and Alarm Output Board functions. RGB video output is provided by J646–J648.

The filterboard provides optical isolation for two sets of alarm contacts that connect to TB1 and TB2. Figure 3.7.8 shows wiring for the alarm circuits. The optical isolators are rated for 5 to 40 VDC maximum and up to 1.0 amp. The isolators are fused as shown in Table 3.7.1.

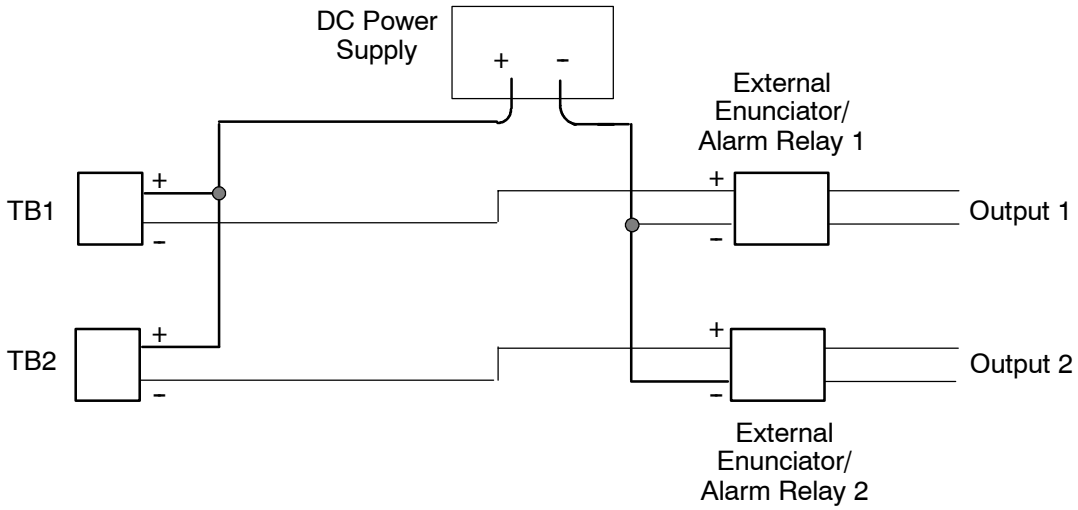


Figure 3.7.8. Alarm Circuit Wiring

CAUTION

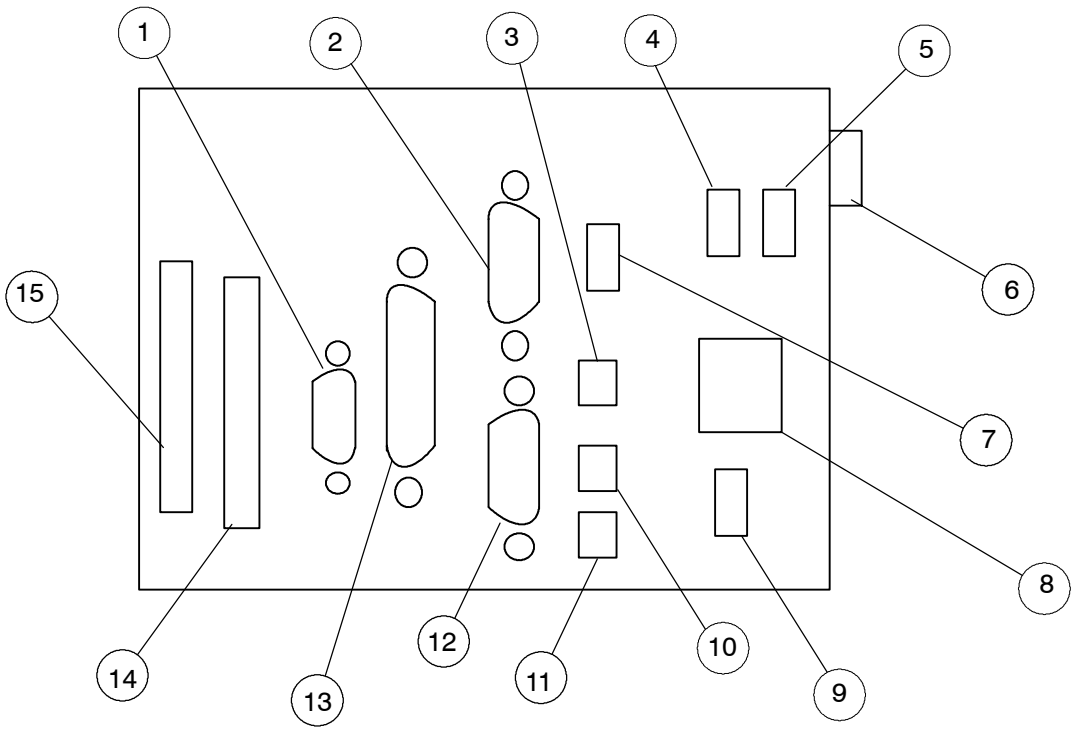
Do not power the alarm circuit with AC. Use of AC and AC-rated optical isolators can result in problems that are very hard to locate.

Table 3.7.5. OI Card Cage 10P5282000x Fuses

Fuse	FRSI Part No.	Bussman Part No.	Characteristics
F1 F2	G09140–0029	MDQ–1-1/2	1.5 A 250 V Slow Blow

OI Card Cage 1984-0660-0001

The 1984-0660-0001 OI Card Cage has an open chassis. Figure 3.7.9 shows the connector layout on the back of this OI Card Cage.



No.	Description	No.	Description
1	RS-422 Keyboard Cable MTCC	9	30 VDC Fan Power red and black wires on older units.
2	Peerway A	10	CRT Color
3	Power	11	CRT Mono
4	Redundant 30 V Power Optional Bus B	12	PeerWay B
5	30 V Power (Bus A)	13	RS-232C Printer Cable
6	Connection for On/Off Switch	14	Tape, Disk or Floppy Drive on SCSI Bus
7	DC Power for Disk, Floppy and Tape Drives	15	Keyboard Cable (old units only)
8	5 VDC Power for Disk Drive, 30 VDC for Keyboard Interface		

Figure 3.7.9. OI Card Cage 1984-0660-0001 (Back View)

PeerWay Interface

The PeerWay Interface (1984-1045-0003) transforms parallel data from the processor bus into synchronous serial data for transmission on the PeerWay. The PeerWay Interface also determines the PeerWay node address of the console and associated OI card cage. It is marked “MC PEERWAY” on the printed wiring assembly (PWA). Figure 3.7.10 shows a block diagram.

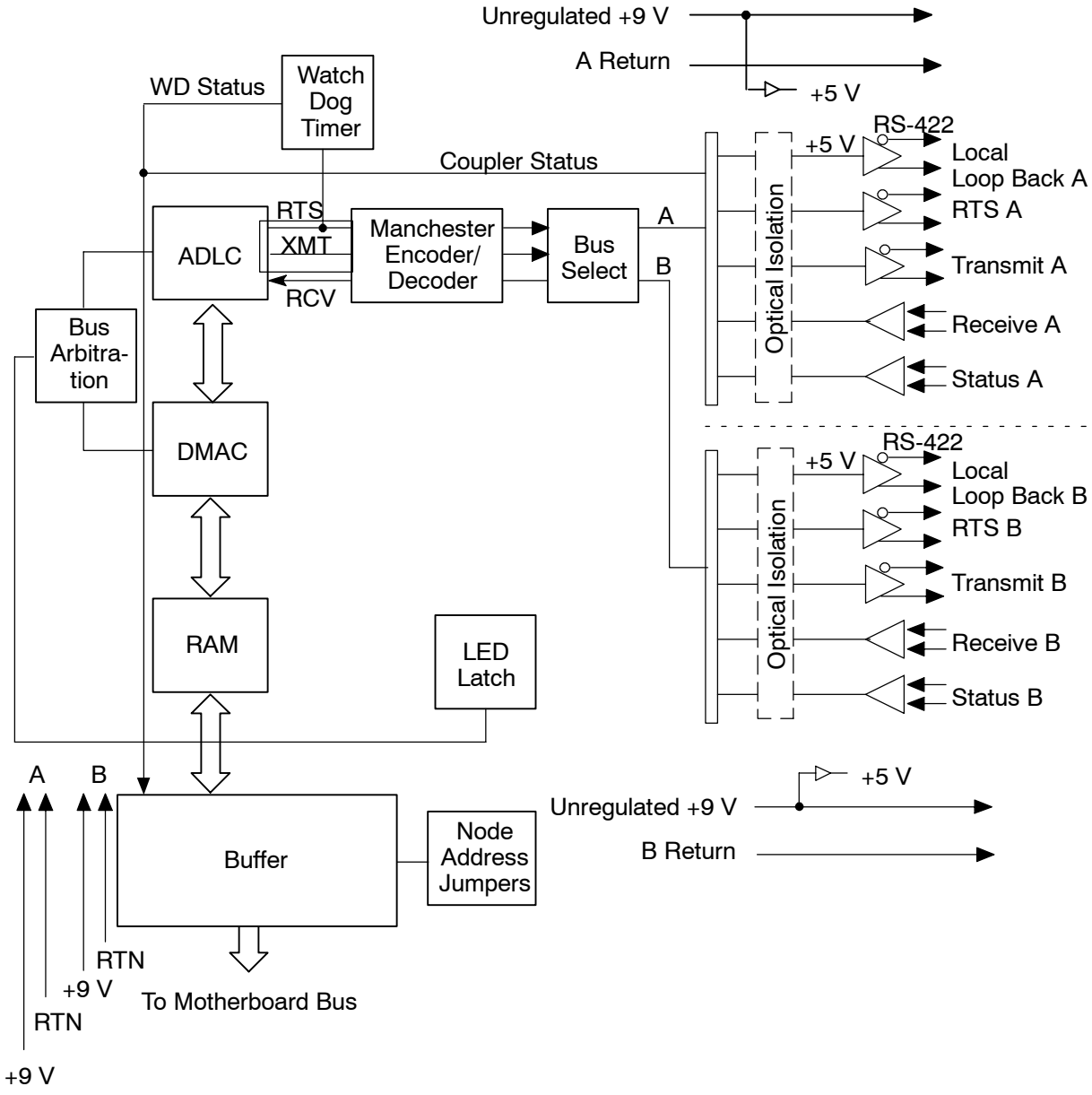


Figure 3.7.10. PeerWay Interface Functional Diagram

NOTE: The PeerWay node address must be an even number. The PeerWay node address is independent of SCSI device addresses used in the Card Cage.

Bus buffers on the PeerWay Interface isolate the board synchronous bus for the Direct Memory Access Controller (DMAC), Advanced Data Link Controller (ADLC), Programmable Timer Module (PTM), write buffer, read buffer, RAM (2K X 8), and a software-driven LED latch.

The RAM buffers transmissions for the PeerWay. The DMAC transfers data from buffer memory to and from the ADLC. The ADLC changes data from parallel to serial for transmission and from serial to parallel data for receiving. The PTM runs the bus access scheme, controlling timeout functions to allow other devices to access the bus at given times.

The Manchester Encoder/Decoder (HD6409) encodes data for transmitting to Non-Return-to-Zero (NRZ) format. NRZ format encodes data and a synchronous clock in the same signal. Rising and falling edges of the transmitter signal keep the phase-lock loop oscillator in the receivers locked onto the transmitter clock frequency.

Serial data is presented to the transmitter section of the card. The transmit and receive sections are connected to the PeerWay Tap by a cable that carries the following signals:

- 9 volts unregulated DC
- Transmit signal (RS-422) to PeerWay
- RTS signal (RS-422) enables PeerWay Tap transmitter
- Local Loop Back Signal (RS-422) enables online relay
- Status (RS-422) returns status of the local loop back (LLB) relay and watchdog timer
- Receive signal (RS-422) from PeerWay

An analog watchdog timer monitors the RTS signal and disables the transmitter if the length of the transmission exceeds 67 milliseconds. A backup watchdog timer on the PeerWay Tap has the same function.

Signals are isolated from chassis ground by special isolated voltages and optical isolators on the PeerWay Interface. TIL 155 OPTOs handle DC signals (RTS, LLB and STATUS), and high speed 6N137s OPTOs manage the transmit and receive signals.

All signals are transmitted in RS-422 format, a differential signal transmission at TTL voltage levels. The two output lines of the transmitter are driven 180 degrees out of phase and a voltage comparator at the receive end changes the signal back to a single TTL line.

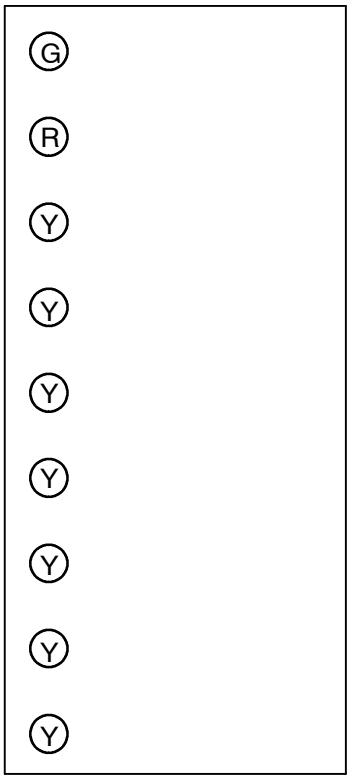
Two 3-terminal voltage regulators are included to regulate the +9 V from the Power Regulator card down to +5 V. The 5 volt sources supply voltage to the A and B PeerWay isolated circuits.

PeerWay Interface LEDs and Test Points

LEDs on the PeerWay Interface card indicate different status conditions. Figure 3.7.11 shows the LEDs.

The test points are:

- TP1 +5V Isolated DC for Tap A (Yellow)
- TP2 A Return (Gray)
- TP3 +5V Isolated DC for Tap B (Yellow)
- TP4 B Return (Gray)



DS1 Card Good	No faults are detected on the card.
DS2 Card Fault	A fault is detected in the communication link.
DS4 PW Tap ST A	The timer in tap A has timed out.
DS5 PW Tap ST B	The timer in Tap B has timed out.
DS6 RTS	Ready to send generated from PeerWay Interface.
DS7 Bus Active	The PeerWay Interface is receiving data.
DS8 A Active	The Interface is using the A PeerWay.
DS9 B Active	The Interface is using the B PeerWay.
DS10 CMD Active.	Command active. The software is actively executing a command on the Interface Board.

Figure 3.7.11. PeerWay Interface LEDs

PeerWay Interface Jumpers

Four jumpers on the PeerWay Interface set the node address of the Console and the OI Card Cage. The sum of the jumper values plus 2 determines the node address, which can only be an even number. Figure 3.7.12 shows the PeerWay Interface jumper locations. Table 3.7.6 shows the jumper values.

Figure 3.7.13 shows the jumper setting for a PeerWay node address of 16. The name of each jumper is marked at the right of the jumper. The least significant (LS) jumper is at the top and the most significant (MS) is at the bottom. A jumper has the listed value in the (1–2) position and a 0 value in the 2–3 position. Total the values and add 2 to get the node address.

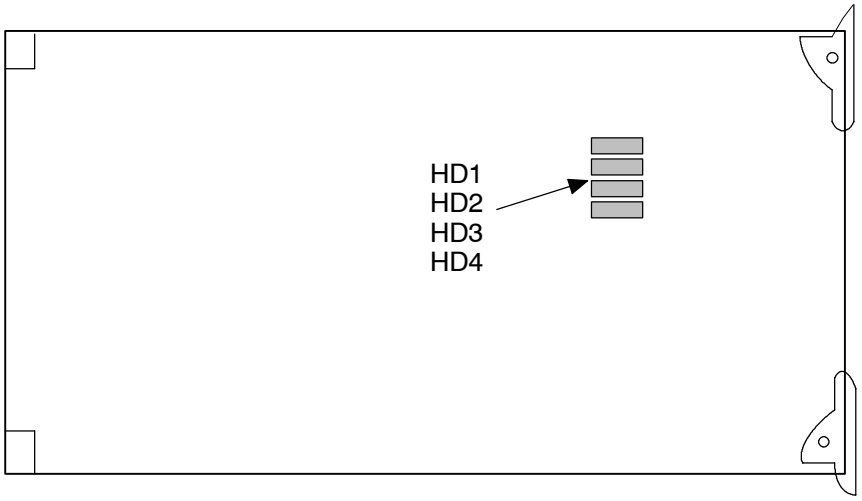


Figure 3.7.12. PeerWay Interface Jumper Locations

Table 3.7.6. PeerWay Interface Jumper Values

Jumper	Value at 1–2	Value at 2–3
HD1	2	0
HD2	4	0
HD3	8	0
HD4	16	0

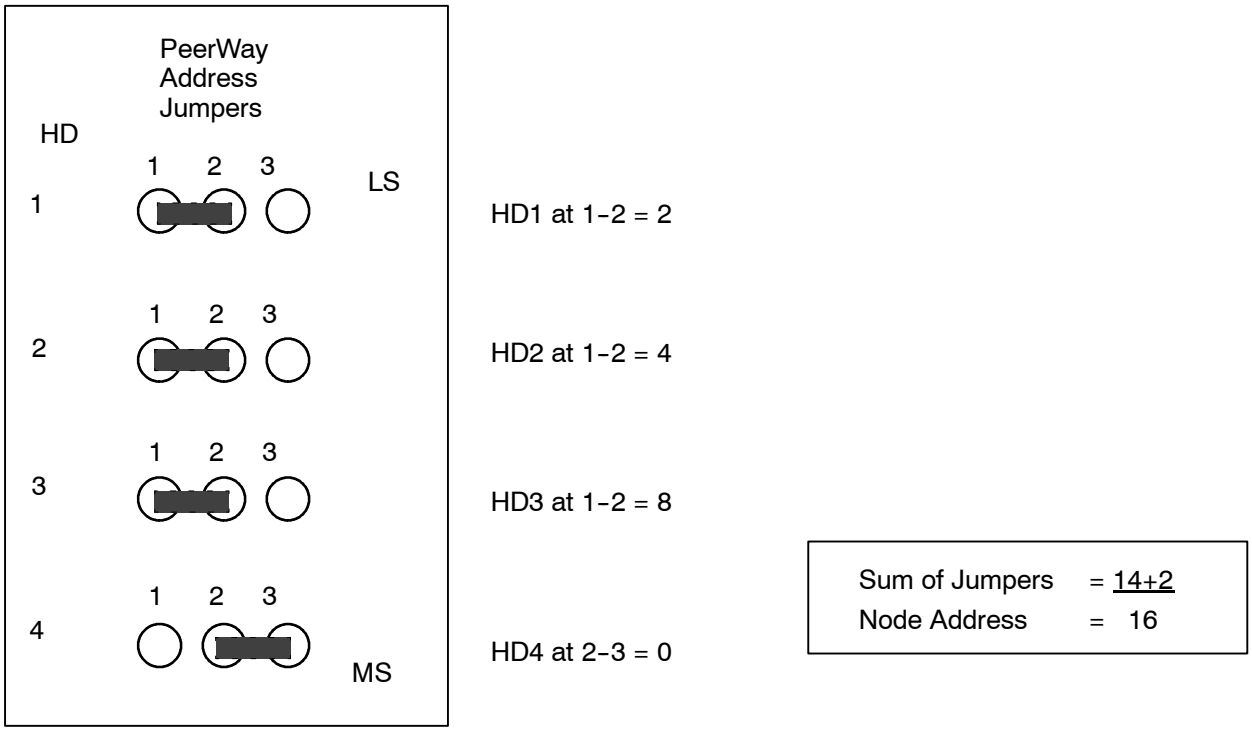


Figure 3.7.13. Setting the Node Address Jumpers

NOTE: Setting the jumper for use on a PeerWay other than PeerWay number 1 requires that you calculate the jumper setting:

Jumper Setting = HN - (P#-1)*32

Where:

HN is the node number as shown on the CCC screen.

P# is the PeerWay number.

The result is the desired jumper setting value.

OI Power Supply

The “OI POWER SUPPLY” (1984-1137-0001) regulates the incoming 30 VDC bus to +5 volts for the OI Card Cage circuitry, and to +12 volts for the CRT and the isolated supplies on the Printer Interface. See Figure 3.7.14 for an OI Power Supply functional diagram. The 1984-1017-000x “MINICON POWER REGULATOR” is replaced by the 1984-1137-0001 OI Power Supply.

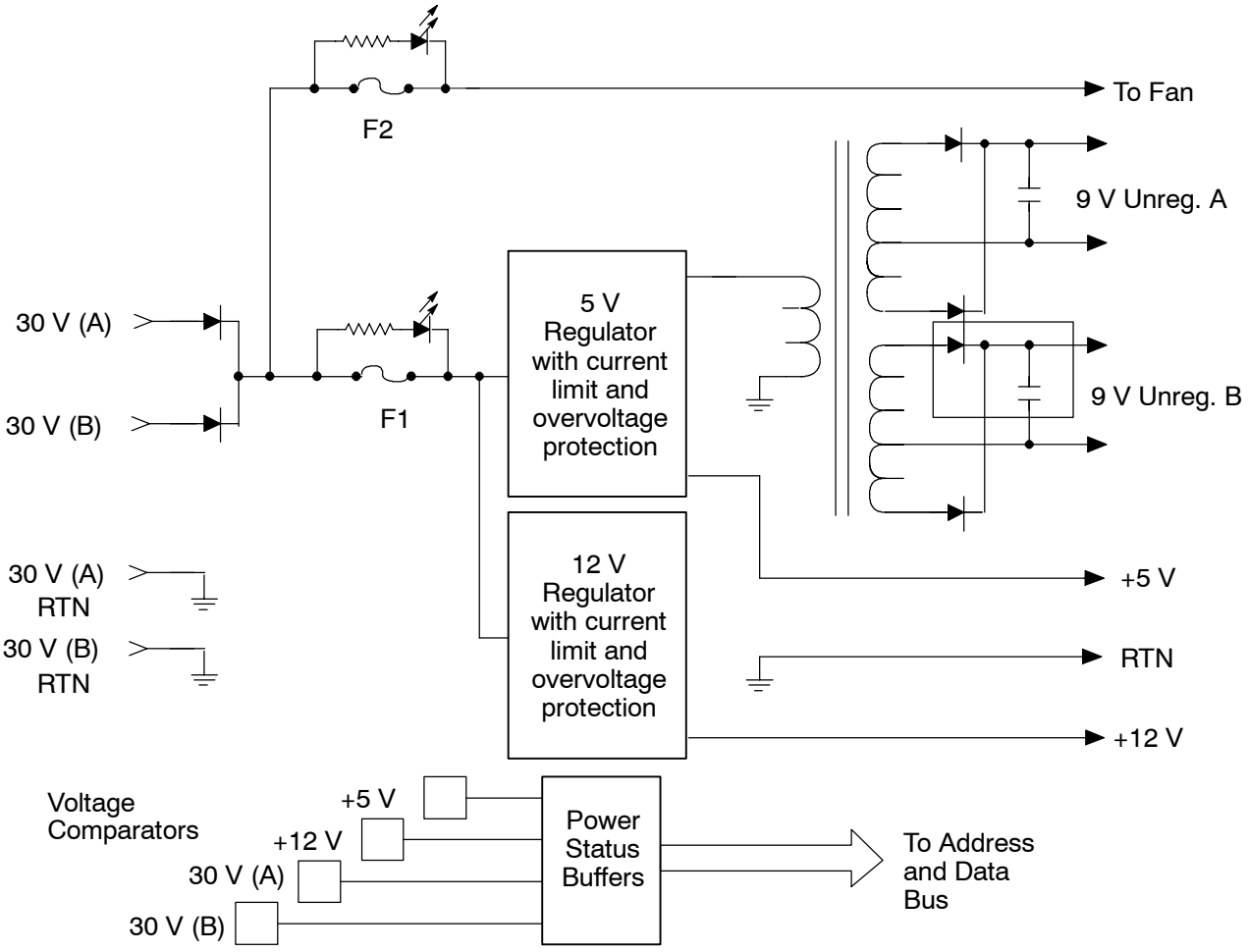


Figure 3.7.14. OI Power Supply Functional Diagram

Input power from power buses A and B is diode isolated and fed through two fuses, F1 and F2. F1 feeds the regulators and F2 feeds power to the DC fan. Each fuse has a red LED indicator.

The 30 VDC supply is applied to the 5 volt switching regulator circuit. This circuit supplies regulated 5 volts and unregulated 9 volts. A voltage sensing and integration network regulates the supply by referencing the oscillations of the 5 volt switching regulator. The regulator chip limits current. The circuit has an overvoltage protection circuit. If voltage goes above a set level, an SCR is turned on, the output is shorted, and fuse F1 is blown.

The 12 volt regulator controls the state of the pass transistor as the buffer/integrator senses voltage changes. The regulator output is filtered and protected from over-voltage conditions. LEDs indicate supply status.

Voltage comparators give a stable voltage source with a zener diode. If the output voltage of the supply goes above or below tolerance levels, the failure LED lights and the status bit to the processor card is set. LEDs indicate output voltage status.

Table 3.7.7 shows parts replacement data. Model 1984-1137-0001 is used in any console. You can jumper the card for 30 VDC input or 24 VDC input. This card has higher current ratings for added current requirements. It has two unregulated +9 volt outputs (500 mA each) that are run to the PeerWay Interface for the isolated +5 volt regulators. When jumpered for 30 volt input, startup voltage is 26 volts and shutdown voltage is 14 volts. When jumpered for 24 volt input, startup voltage is 20 volts and shutdown voltage is 11.4 volts.

Model 1984-1017-000x is an earlier version used in the MiniConsoles, Basic Command Consoles, and SCIs.

Table 3.7.7. OI Power Supply Parts Replacement

Part Number	Replaces	Characteristics	Comment
1984-1137-0001	1984-1017-0001	24 VDC or 30 VDC Input 12 V Output 3 Amps 5 V Output 20 Amps	Replaces any 1984-1017-000x
1984-1017-000x		30 VDC Input 12 V Output 2 Amps 5 V Output 11 Amps	

OI Power Supply LEDs and Test Points

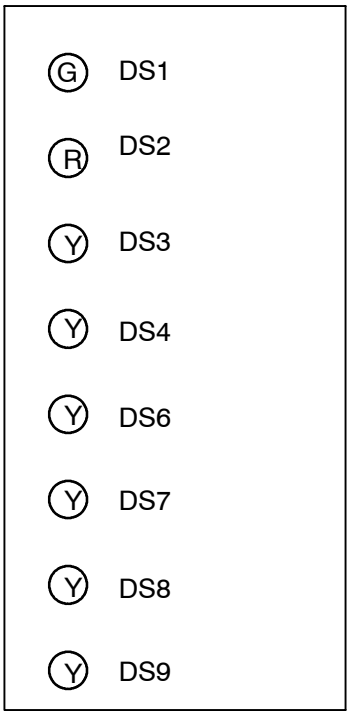
The OI Power Supply has LEDs to monitor the voltages as shown in Figure 3.7.15. Power from power buses A and B is diode isolated and fed through fuses F1 and F2. An LED indicates if a fuse has opened.

There are test points for the +5 volt (yellow-brown) and +12 volt (Red-Brown) supplies.

Model 1984-1137-0001 has two sets of purple and gray test points for the 9-volt unregulated supplies that power the PeerWay Tap Boxes.

NOTE: Read voltages at the PeerWay Tap Box; not at the card itself.

To determine the card's condition, install the card alone in the card cage and observe the LEDs.



DS1=Card Good. Comparators are within tolerance.

DS2=Card Fault. +5 V or +12 V comparator has sensed voltage out of tolerance.

DS3=Fuse F1 is bad. (Regulator)

DS4=Fuse F2 is bad. (Fan)

DS6=+5 V Good. The +5 V comparator is within tolerance.

DS7=+12 V Good. The +12 V comparator is within tolerance.

DS8=+30 V Bus A Good. The 30 VDC power bus A is within tolerance.

DS9=+30 V Bus B Good. The 30 VDC power bus B is within tolerance.

Figure 3.7.15. OI Power Supply LEDs

OI Power Supply Jumpers

The 1984-1137-0001 OI Power Supply may be jumpered for 30 VDC or 24 VDC input. Figure 3.7.16 shows jumper locations. Table 3.7.8 gives jumper positions for the two input voltages.

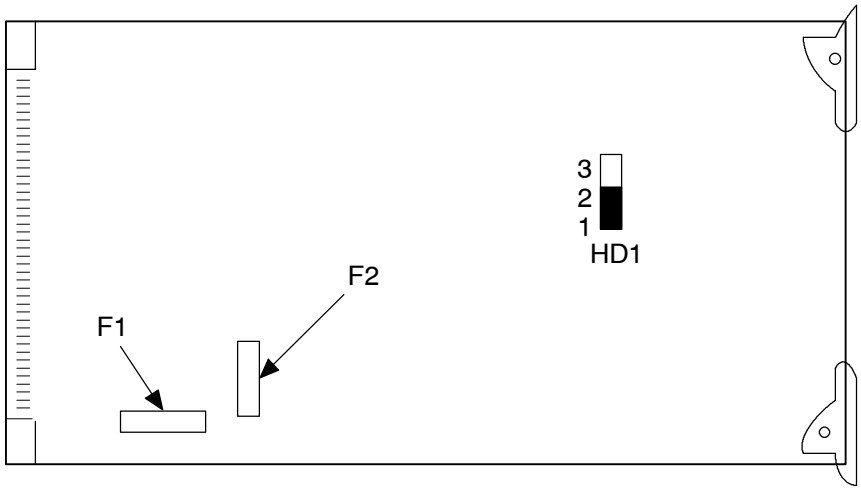


Figure 3.7.16. 1984-1137-000x OI Power Supply Fuse and Jumper Locations

Table 3.7.8. 1984-1137-000x OI Power Supply Jumper Settings

Jumper HD1 Position	Input Voltage
1-2	30 VDC
2-3	24 VDC

OI Power Supply Jumpers for a System Power Supply Unit

The power regulators for the ControlFile and OI card cage must be set to use 24 VDC. Jumpers on the ControlFile Power Regulator and OI Power Regulator must be set for 24 VDC as shown in Table 3.7.9.

Table 3.7.9. OI Jumper Settings for a System Power Supply Unit

Regulator	Header	Position
OI Power Regulator (01984-1137-000x)	HD1	2-3
ControlFile Power Regulator (01984-3505-000x)	HD1	1-2

OI Power Supply Fuses

Figure 3.7.16 shows the locations of the OI Power Supply fuses. Table 3.7.10 shows fuse data.

Table 3.7.10. OI Power Supply Fuses

Card	Fuse	FRSI Part No.	Bussman Part No.	Littelfuse Part No.	Characteristics
1984-1137-000x	F1	G09140-0047	AGC 15	311015	15 A 32 V Regular
	F2	G09140-0023	MDQ 1	313001	1 A 250 V Slow Blow
1984-1017-000x	F1	G09140-0044	AGC 7-1/2	31107.5	7.5 A 32 V Regular
	F2	G09140-0023	MDQ 1	313001	1 A 250 V Slow Blow

OI Processor

The OI Processor family is offered in these groups:

- OI 68040
  - 10P5527001x marked “OI PROCESSOR V”
  - 1984-3202-00xx marked “OI PROCESSOR V”
- OI 68020
  - 1984-1540-000x marked “OI PROCESSOR 68020 W/ASIC”
  - 1984-1161-0008 marked “OI PROCESSOR 68020”
- OI 68000
  - 10P57140008 and 1984-2759-0008 marked “OI PROCESSOR III”
  - 1984-2137-0008 marked “OI PROCESSOR 1 MEG”
  - 1984-2122-0007 marked “OI PROCESSOR 1 MEG”
  - 1984-2120-0008 marked “OI PROCESSOR”
  - 1984-2107-0005 marked “OI PROCESSOR”
  - 1984-1061-0005 marked “OI PROCESSOR”

Each group is described individually in this section.

The OI Processor family is used in the:

- Multitube Command Console (MTCC)
- Command Console (CC)
- MiniConsole (MC)
- Basic Command Console (BCC)
- Supervisory Computer Interface (SCI)
- Highway Interface Adapter (HIA)
- System Resource Unit (SRU)
- Diogenes Interface.

Table 3.7.11 lists the models, the RAM size, and the equipment when the part is applicable.

NOTE: Some software versions require at least 1 Meg of memory. The OI Processor 68020 (1984-1540-000x or 1984-1161-000x) may replace any of the OI Processor cards listed below them, but new software and pixel graphics are required.

Table 3.7.11. OI Processor Replacement Data

Part Number	Replaces	RAM	Used In	PWA Marked
10P55270011	–	16 Meg	SMS	OI PROCESSOR V
10P55270010	1984-3202-0010	16 Meg	MTCC	OI PROCESSOR V
1984-3202-0010	1984-1540-0009 1984-1161-000x	16 Meg	MTCC	OI PROCESSOR V
1984-1540-0009 1984-1161-000x	All below **NOTE:** Use of this processor requires pixel graphics and may require changing of software.	4 Meg	MTCC	OI PROCESSOR 68020 W/ASIC OI PROCESSOR 68020
10P57140008	1984-2759-0008	2 Meg	MC CC MTCC HIA SCI	OI PROCESSOR III
1984-2759-0008	All below	2 Meg	MC CC MTCC HIA SCI	OI PROCESSOR III
1984-2137-0008	All below	1 Meg	MC BCC CC MTCC HIA SCI	OI PROCESSOR 1 MEG
1984-2122-0007	All below	1 Meg	BCC CC	OI PROCESSOR 1 MEG
1984-2120-0008	1984-2107-0005 1984-1061-0005	1/2 Meg	MC BCC	OI PROCESSOR
1984-2107-0005	1984-1061-0005	1/2 Meg	MC BCC	OI PROCESSOR
1984-1061-0005		1/2 Meg	MC BCC	OI PROCESSOR

OI Processor 68040

OI Processor 68040 (1984-3202-0010, 10P55270010, and 10P55270011) is marked “OI PROCESSOR V” on the printed wiring assembly (PWA). It performs 68020 or 68000 OI processor functions but has more memory and is enhanced for increased performance. Replacing an older OI Processor with this card requires pixel graphics and may require new software.

The major functional blocks of the card are the:

- 68040 microprocessor
- Clock, Watch Dog, and Interrupt Encoder
- Main Memory Interface (MMI) Application Specific Integrated Circuit (ASIC)
- Dynamic RAM (16 MB)
- Erasable Programmable Read-Only Memory (EPROM) for the boot program (128KB)
- Static Random Access Memory (SRAM) (512KB Zero Wait State)
- Dual Universal Asynchronous Receiver/Transmitter (DUART) (Optional, for software debugging)
- Buffered Motherboard Interface (BMI) for the 68000 motherboard bus
- Hardware read and write latches

Figure 3.7.17 shows the functional diagram for an OI Processor 68040.

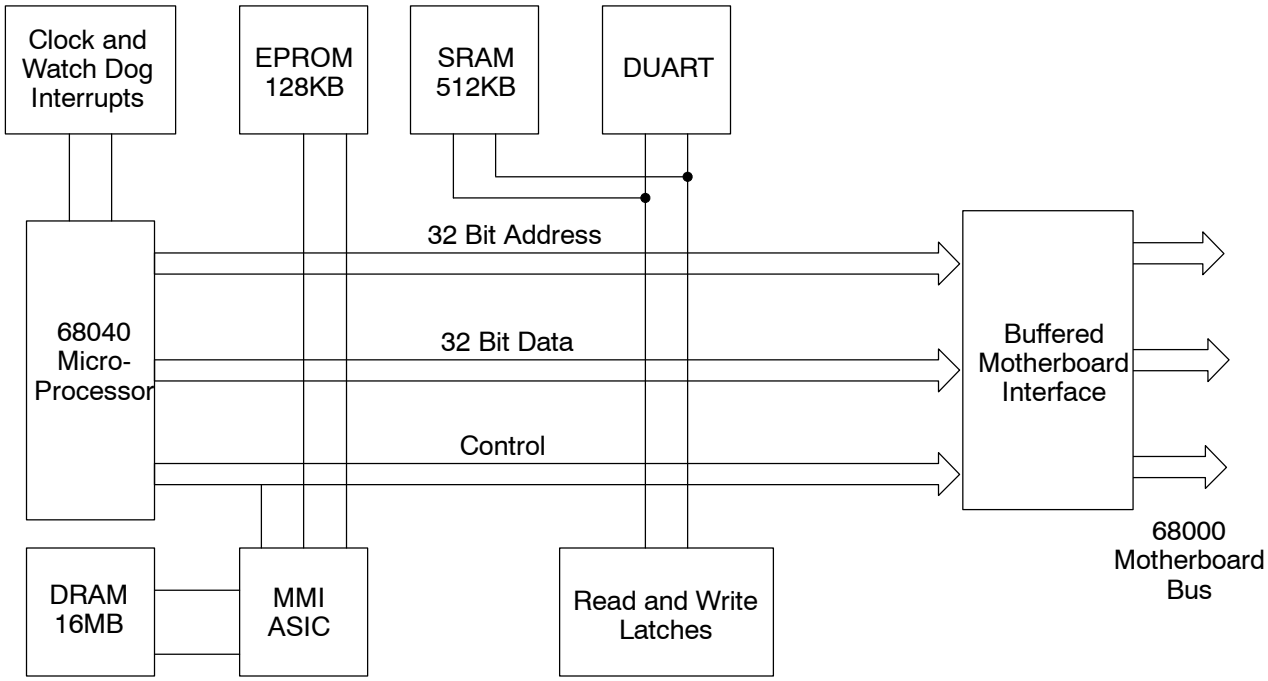


Figure 3.7.17. OI Processor 68040 Functional Diagram

The OI Processor 68040 runs at a clock rate of 50 and 25 MHz. The 68040 microprocessor runs internally at 50 MHz, and all external bus operations are timed by the 25 MHz clock. There are internal 2KB instruction and data caches. It has a full 32-bit data bus and address bus. Because the 68040 does not have dynamic bus sizing, the buffered motherboard interface communicates with the 16-bit Motherboard Bus.

In the 68040 support circuitry, the watchdog timer generates a reset to the processor if the processor hangs up.

The 68040 has 128KB of EPROM to store the boot program, the power up diagnostics, the PeerWay Boot program, and a debugging program.

The Main Memory Interface (MMI) ASIC controls the Dynamic Random Access Memory (DRAM) and performs the Error Detection and Correction (EDAC) function.

The dynamic RAM is 16 megabytes, arranged as 4 Meg x 32 plus 4 Meg x 7 for EDAC syndrome bits. The EDAC generates a 7-bit check word from a 32-bit data word to detect and correct all DRAM signal bit errors.

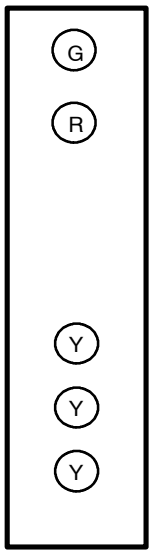
A 512KB Fast Static RAM is used for code that must run faster than normal, such as interrupt routines.

The 68040 uses the same motherboard as the 68000-based OI Processor Card. The Buffered Motherboard Interface (BMI) generates the 68000 compatible signals.

The 68040 does not have the keyboard buffers found on the 68000 OI Processor cards. Keyboard communications are handled by the printer interface board.

OI Processor 68040 LEDs

Figure 3.7.18 shows the OI Processor 68040 LEDs.



DS1 Card Good. No faults are detected on the card.

DS2 Card Fault. A fault has been detected on the Processor Card.

DS6 Display Active. Processor is updating Video Generator RAM.

DS7 Keyboard Active. Processor is operating on an instruction from a keyboard.

DS8 Controller I/O. Processor is working on a data update from a Controller.

Figure 3.7.18. OI Processor 68040 LEDs

OI Processor 68040 Jumpers

Table 3.7.12 shows the jumper settings.

Table 3.7.12. OI Processor 68040 Jumper Positions

Jumper	Position 1-2	Position 2-3
HD1	Not used	Hard wired
HD2	Not used	Hard wired
HD3	PeerWay Boot	Disk Boot (Normal)
HD4	Not used	Hard wired
HD5	Not used	Hard wired
HD6	Not used	Hard wired

OI Processor 68040 Fuses

The OI Processor 68040 has no fuses.

OI Processor 68020

The OI Processor 68020 (1984–1540–0009 and 1984–1161–0009) is used in consoles and System Resource Units (SRUs) requiring larger memory and faster processing than that provided by the 68000-based OI Processor.

1984–1540–0009 is marked “OI PROCESSOR 68020 W/ASIC” on the PWA. The daughterboard circuitry is contained in Application Specific Integrated Circuit (ASIC) chips.

1984–1161–0009 is marked “OI PROCESSOR 68020” on the PWA. This card has an attached daughterboard.

The OI Processor 68020 performs 68000-based OI Processor functions, but has more memory and is enhanced for increased performance. Replacing an OI Processor with this card requires new software and pixel graphics. Figure 3.7.19 shows the functional diagram for an OI Processor 68020.

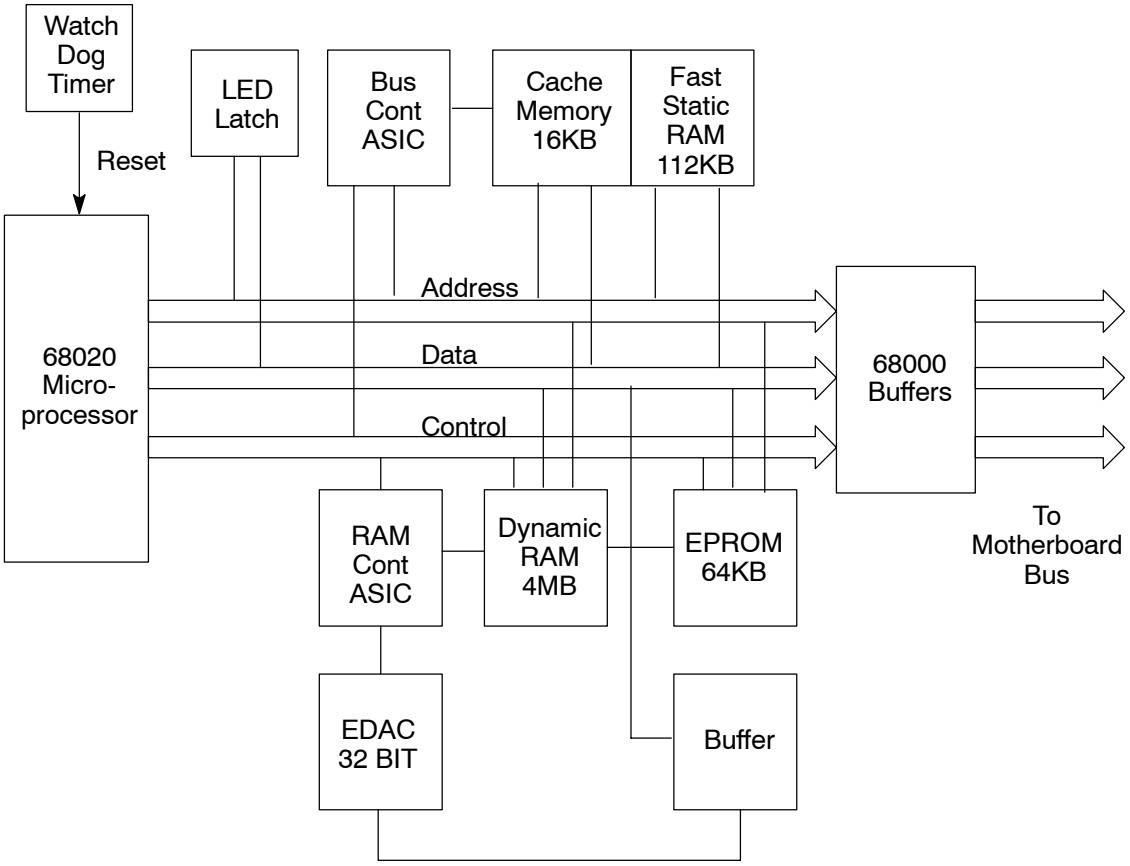


Figure 3.7.19. OI Processor 68020 Functional Diagram

The major functional blocks of the card are:

- 68020 microprocessor and support circuitry
- EPROM for the boot program
- Application Specific Integrated Circuit (ASIC) Bus Controller and ASIC RAM Controller
- Dynamic RAM with error detection and correction circuitry
- External cache memory
- Fast Static RAM (zero wait-state memory)
- Interface for the 68000 motherboard

The OI Processor 68020 runs at a clock rate of 16 MHz. It has a full 32-bit data bus and address bus. The 68020 microprocessor has dynamic bus sizing, which allows the processor to interface to devices of any size from 8 to 32 bits, in 8-bit increments.

The OI Processor 68020 has an internal 256 byte instruction cache memory to speed processing of tight loops. Also, to reduce the time to execute an instruction, the processor decouples the instruction execution portion from the instruction fetch portion, which enables the processor to execute an instruction while pre-fetching the next instruction.

As part of the 68020 support circuitry, the watchdog timer generates a reset to the processor should the processor hang. LEDs are driven on the card by a latch to indicate card status.

The OI Processor 68020 has 128K bytes of EPROM memory that is used to store the boot program, the power up diagnostics, the PeerWay Boot program, and a debugging program.

The Bus Controller ASIC generates the control signals for the external cache memory, the Fast Static RAM memory, and the 68000 motherboard interface. The Bus Controller ASIC also generates the signals that are used by the processor to determine external bus size and transfer status of the current bus cycle.

The RAM Controller ASIC generates all control signals for the EDAC (error detection and correction) circuitry and the dynamic RAM memory, and it multiplexes the addresses for the dynamic RAM memory.

The dynamic RAM memory array is 1 megabyte by 32 bits, or 4 megabytes. The OI Processor Card 68020 uses 1 megabit by 1 bit dynamic RAM devices. The memory array requires a total of 39 parts: 32 parts for data and 7 parts for the check bits used in the EDAC.

The error detection and correction (EDAC) circuitry contains a 32-bit EDAC. The EDAC generates a 7-bit check word from a 32-bit data word to detect and correct all signal bit errors in the dynamic RAM memory.

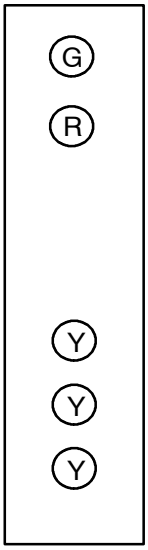
In addition to the internal cache memory on the 68020 processor, there is a 16K byte external cache memory and a 112K byte Fast Static RAM memory. The Fast Static RAM contains code that is required to run faster than normal, such as interrupt routines.

The OI Processor 68020 uses the same motherboard as the 68000-based OI Processor Card. The required 68000 compatible signals are generated by the Bus Controller ASIC.

The OI Processor 68020 does not have the keyboard buffers found on the 68000 OI Processor cards. Keyboard communications are handled through the printer interface board.

OI Processor 68020 LEDs

Figure 3.7.20 shows the OI Processor 68020 LEDs.



DS1	Card Good. No faults are detected on the card.
DS2	Card Fault. A fault has been detected on the Processor Card.
DS6	Display Active. Processor is updating Video Generator RAM.
DS7	Keyboard Active. Processor is operating on an instruction from a keyboard.
DS8	Controller I/O. Processor is working on a data update from a Controller.

Figure 3.7.20. OI Processor 68020 LEDs

OI Processor 68020 Jumpers

Figure 3.7.21 shows the location of the movable jumpers on the 68020. Table 3.7.13 gives jumper positions. Jumpers HD1, HD2, and HD6 are hardwired.

NOTE: Cards with Boot ROM 9.15 or greater automatically do a PeerWay boot after three failures to boot from disk. This is done even if HD3 is set to Disk Boot.

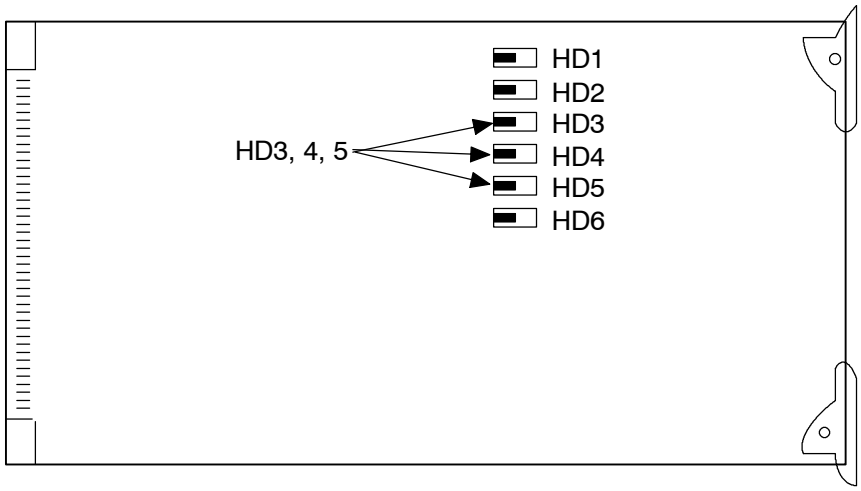


Figure 3.7.21. OI Processor 68020 Jumper Locations

Table 3.7.13. OI Processor 68020 Jumper Positions

Jumper	Position 1-2	Position 2-3
HD3	PeerWay Boot	Disk Boot (Normal)
HD4	Not used	Factory set
HD5	Not used	Factory set

OI Processor 68020 Fuses

There are no fuses on the OI Processor 68020.

OI Processor 68000

The OI 68000 PWA can be marked:

- “OI PROCESSOR III”
- “OI PROCESSOR 1 MEG”
- “OI PROCESSOR”

The OI Processor 68000 controls these functions:

- EPROM Memory timing
- Dynamic RAM timing
- Motherboard bus buffering
- Reading Power Regulator Status bits
- Screen RAM update
- PeerWay communications
- Disk operations
- Printer
- Reading Real-Time Clock
- NVRAM update
- Keyboard operation

The OI Processor 68000 has five main circuits:

- Microprocessor
- RAM
- ROM
- Motherboard bus buffers
- Keyboard buffers

Figure 3.7.22 shows a functional diagram of the card.

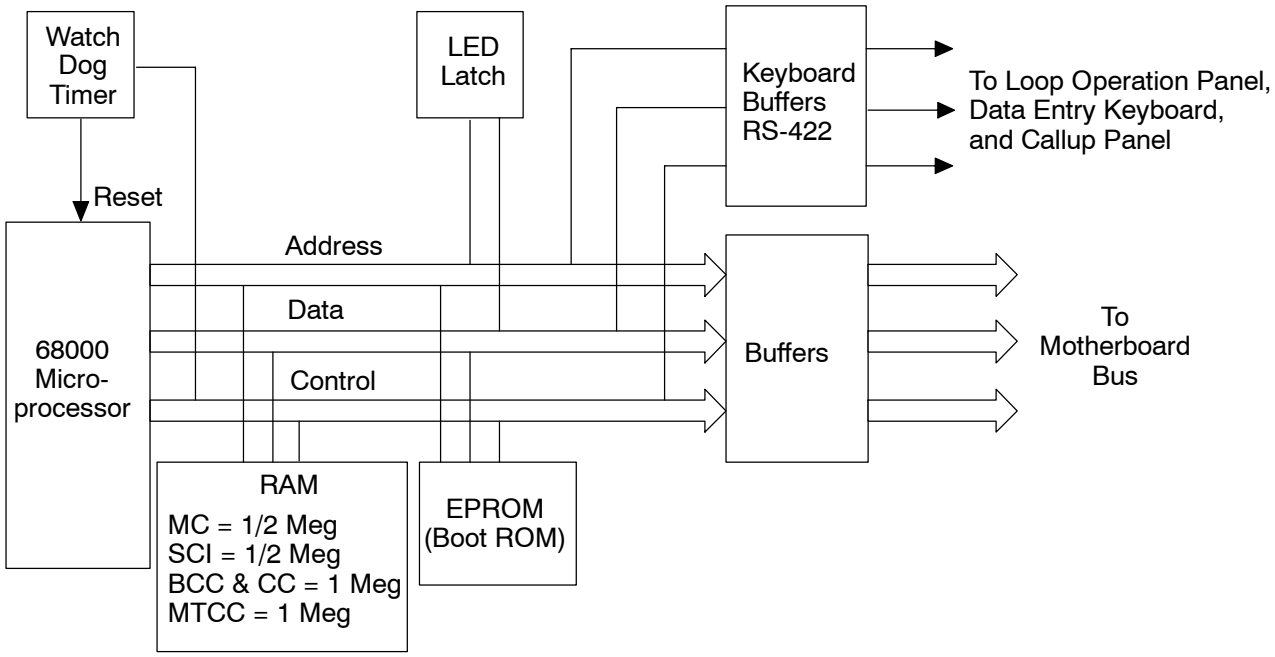


Figure 3.7.22. OI Processor 68000 Functional Diagram

The microprocessor is a Motorola 68000 running at a clock rate of 12 MHz, which is provided by the onboard clock. The watchdog circuit provides two functions for the microprocessor: a low-level interrupt and a hardware reset. The microprocessor has approximately 67 milliseconds to respond to the watchdog low-level interrupt before the watchdog issues a reset signal to the microprocessor.

LEDs are driven on the card by a software latch to indicate good/bad and card status.

The Programmable Array Logic chips (PAL) provide address decoding for all individual circuits on the card.

The card contains the dynamic RAM and the Error Detection and Correction (EDAC) control circuitry. The Dynamic Memory Controller does the required address multiplexing for the RAM chips and handles the refresh cycle. The dynamic RAM chips have separate pins for the read and write functions. A separate Read/Write select function provides the separation and data bus buffering. The EDAC Controller decodes the check bits that are stored along with the data bits. A 22-bit word is stored in dynamic RAM with 16 data bits and six check bits. If any single bit error is indicated by the EDAC check bits, the EDAC controller will automatically correct the error and rewrite the data into the dynamic RAM location. If any multiple bit errors are found, the EDAC will trigger a bus error, which causes the board to reset and indicate problems to the operator.

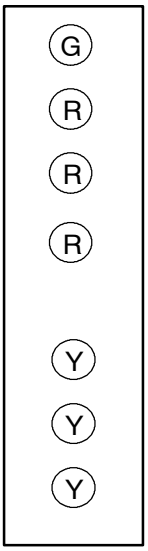
One pair of EPROMs provides a program for power up diagnostics. They contain information necessary for downloading the operating program from a disk or tape.

The first 20 pins in each card slot are dedicated to I/O for that slot. Pins 1 through 20 of the OI Processor 68000 edge connector are for interface with the loop callup keyboard and remote callup panels using the RS-422 protocol.

Fusing is provided for the +5 and +30 volt inputs. There are also address and data bus buffers for the motherboard bus lines that communicate to the cards in the card cage.

OI Processor 68000 LEDs

Figure 3.7.23 shows the OI Processor 68000 LEDs.



DS1	CARD GOOD. No faults are detected on the card.	
D2S	CARD FAULT. A fault has been detected on the Processor Card.	
DS3	EXT LOOP SEL 30V FUSE. Fuse F1 is bad.	
DS4	FUSE BLOWN. 5V Keyboard fuse blown.	
DS6	DISPLAY ACTIVE	Processor is updating Video Generator RAM.
DS7	KEYBOARD ACTIVE	Processor is operating on an instruction from a keyboard.
DS8	CONTROLLER I/O	Processor is working on a data upgrade from a Controller.

Figure 3.7.23. OI Processor 68000 LEDs

OI Processor 68000 Jumpers

Figure 3.7.24 shows the location of the one movable OI Processor 68000 jumper. The 10P57140008/1984-2759-000x model has no movable jumpers. Table 3.7.14 shows jumper positions and effects for the OI Processor 68000.

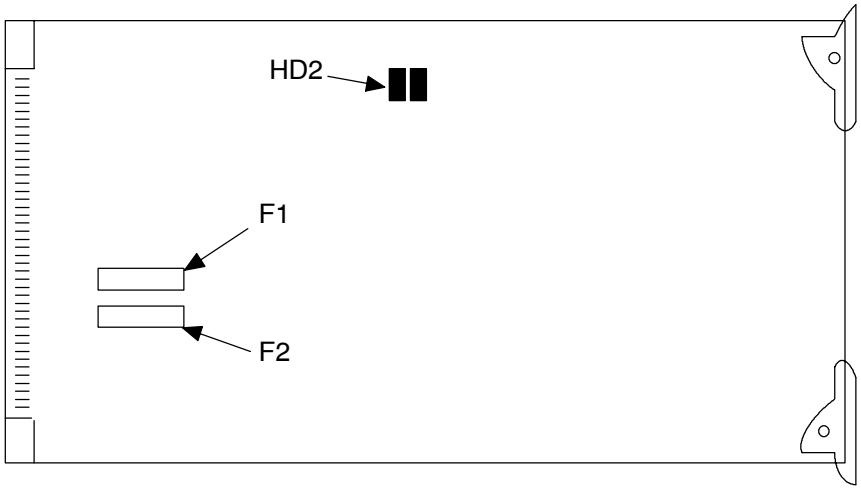


Figure 3.7.24. OI Processor 68000 Fuse and Jumper Location

Table 3.7.14. OI Processor 68000 Jumper Positions

Card	Jumper HD2 Position 2-3	Jumper HD2 Position 1-2
1984-2759-0008	No movable Jumpers	No movable Jumpers
1984-2137-0008 1984-2122-0007 1984-2120-0008 1984-2107-0005 1984-1061-0005	256K EPROM installed (Normal)	128K EPROM installed

OI Processor 68000 Fuses

Figure 3.7.24 shows the fuse locations for the OI Processor 68000. Table 3.7.15 shows fuse data.

NOTE: Fuses on the OI Processor 68000 III are in the same area, but are oriented vertically.

Table 3.7.15. OI Processor 68000 Fuses

Fuse	FRSI Part No.	Bussman Part No.	Littelfuse Part No.	Characteristics
F1	G09140-0036	MDL-3	313003	3A 250 V Slow Blow
F2	G09140-0041	MDL-5	312005	5 A 250 V Regular

Pixel Graphics Video Generator

The Pixel Graphics Video Generator (10P58900001 or 1984-2503-0001) generates color video signals for the command console CRT. It is marked “OI GRAPHICS VIDEO GEN” on the PWA. It uses a 30.5 KHz horizontal scan rate. Figure 3.7.25 is a schematic diagram of the card.

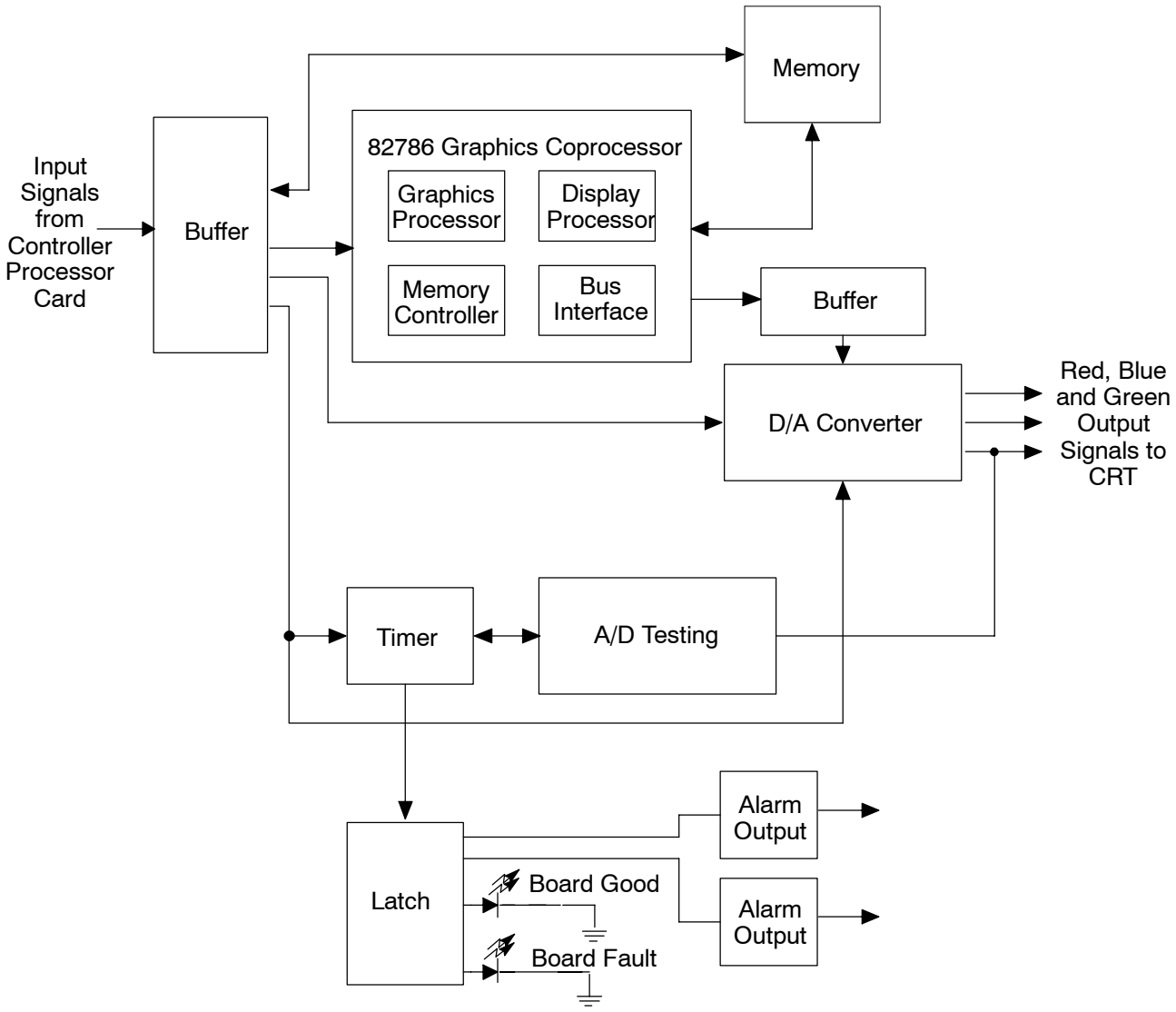


Figure 3.7.25. Pixel Graphics Video Generator Functional Diagram

The inputs to the Pixel Graphics Video Generator include address lines and data lines from the Console Processor through the console motherboard. The input signals include the DTACK signal for synchronization, the SYSTEM CLOCK signal, and the RESET signal.

The output signals of the Pixel Graphics Video Generator include red, blue, and green color signals and alarm contact signals. The color signals are sent to the CRT monitor. The alarm contact signals are sent to the Alarm Output Panel. Video information goes out with the red, blue, and green color signals. In addition, the sync signal is superimposed on the green color signal.

There are three major parts of the Pixel Graphics Video Generator:

- the 82786 graphics coprocessor
- the memory
- the video output section

The 82786 graphics coprocessor includes a graphics processor, a display processor, a memory controller, 1 Meg video RAM, and a bus interface unit. The 82786 graphics processor draws all geometric objects and characters with attributes such as color, texture, path, rotation, and proportional spacing. The display processor takes the bitmaps generated by the graphics processor or external processor, organizes the data, and displays the bitmaps as a window on the screen. The display processor generates and synchronizes the Horizontal Synch, Vertical Synch, and Blank signals to the CRT display. The console processor loads a character set into memory on power up. The bus interface unit controls communication between the 82786 coprocessor and the Console Processor.

The memory array has a 2 Meg capacity (currently stuffed to 1 Meg). Sixteen bits of data can be accessed at one time, either by the coprocessor or by the console processor.

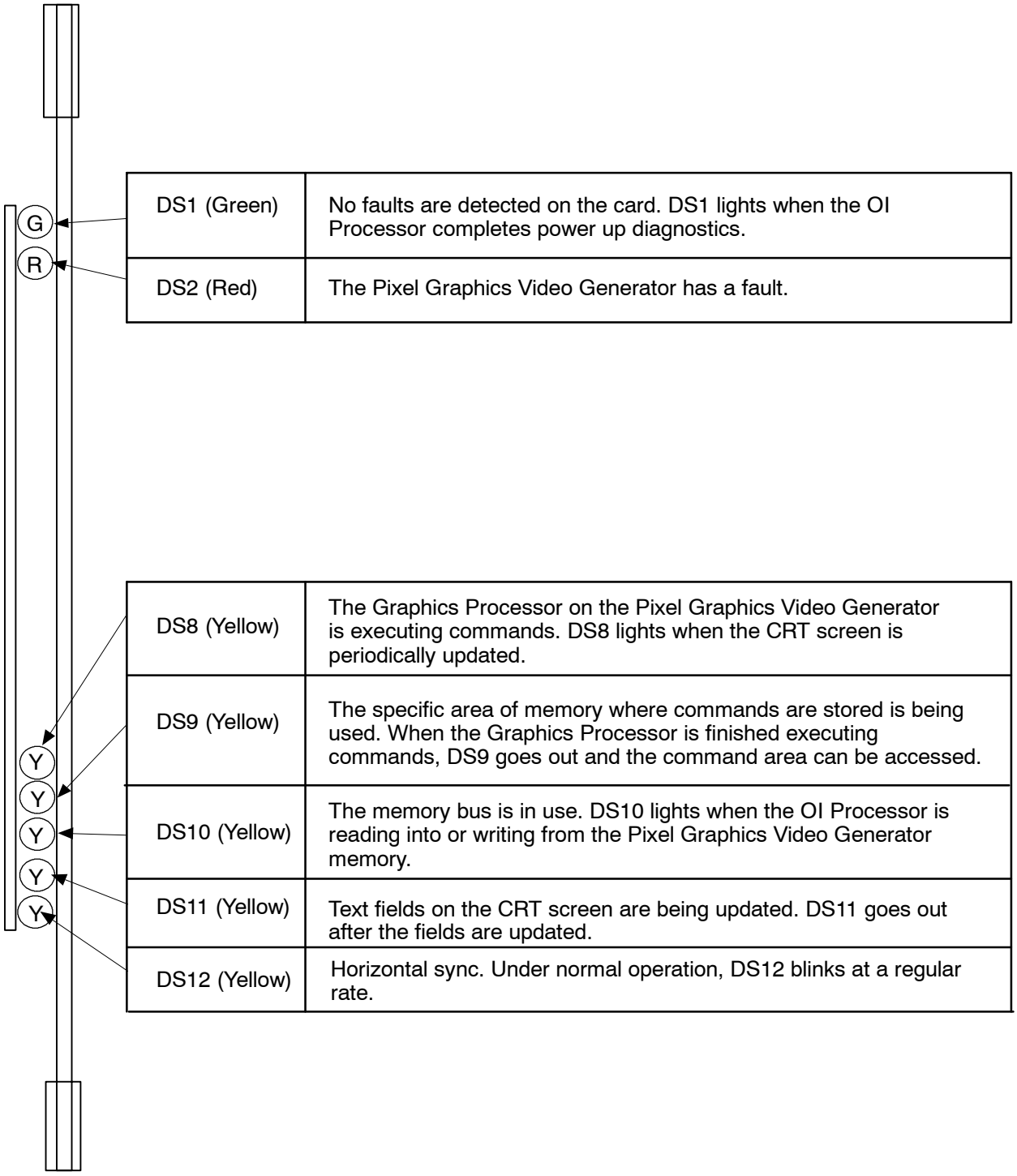
The video output section includes three digital-to-analog converters (DACs) that convert the digital signal from the display processor into analog signals that drive the red, blue, and green electron guns. The 4-bit digital signal from the display processor defines the pixel color by pointing to an address in an array. Each address has 24 bits divided into 3 sets of 8 bits each. Each set of 8 bits defines color intensity for the red, blue, or green color signal.

In the output section, a parallel interface unit drives the blanking signal, the LEDs, and the alarm contact; and tests the outputs. As part of the testing, the parallel interface unit takes the voltage comparators output and checks synch level, green level, red level, and blue level for frequency and amplitude. Output of the voltage comparators appears as horizontal red, blue, and green lines on the CRT during power up.

There are two clocks on the Pixel Graphics Video Generator: a 25 MHz video clock and a 20 MHz processor clock.

Pixel Graphics Video Generator LEDs

The Pixel Graphics Video Generator has LEDs to indicate status. Figure 3.7.26 shows the LEDs.



DS1 (Green)	No faults are detected on the card. DS1 lights when the OI Processor completes power up diagnostics.
DS2 (Red)	The Pixel Graphics Video Generator has a fault.
DS8 (Yellow)	The Graphics Processor on the Pixel Graphics Video Generator is executing commands. DS8 lights when the CRT screen is periodically updated.
DS9 (Yellow)	The specific area of memory where commands are stored is being used. When the Graphics Processor is finished executing commands, DS9 goes out and the command area can be accessed.
DS10 (Yellow)	The memory bus is in use. DS10 lights when the OI Processor is reading into or writing from the Pixel Graphics Video Generator memory.
DS11 (Yellow)	Text fields on the CRT screen are being updated. DS11 goes out after the fields are updated.
DS12 (Yellow)	Horizontal sync. Under normal operation, DS12 blinks at a regular rate.

Figure 3.7.26. Pixel Graphics Video Generator LEDs

Character Graphics Video Generator

The Character Graphics Video Generator card (1984–1064–0001) generates color video signals for the command console CRT. It is marked “OI COLOR VIDEO” on the PWA. It uses a 15.5 KHz horizontal scan rate. Figure 3.7.27 shows a functional diagram of the card.

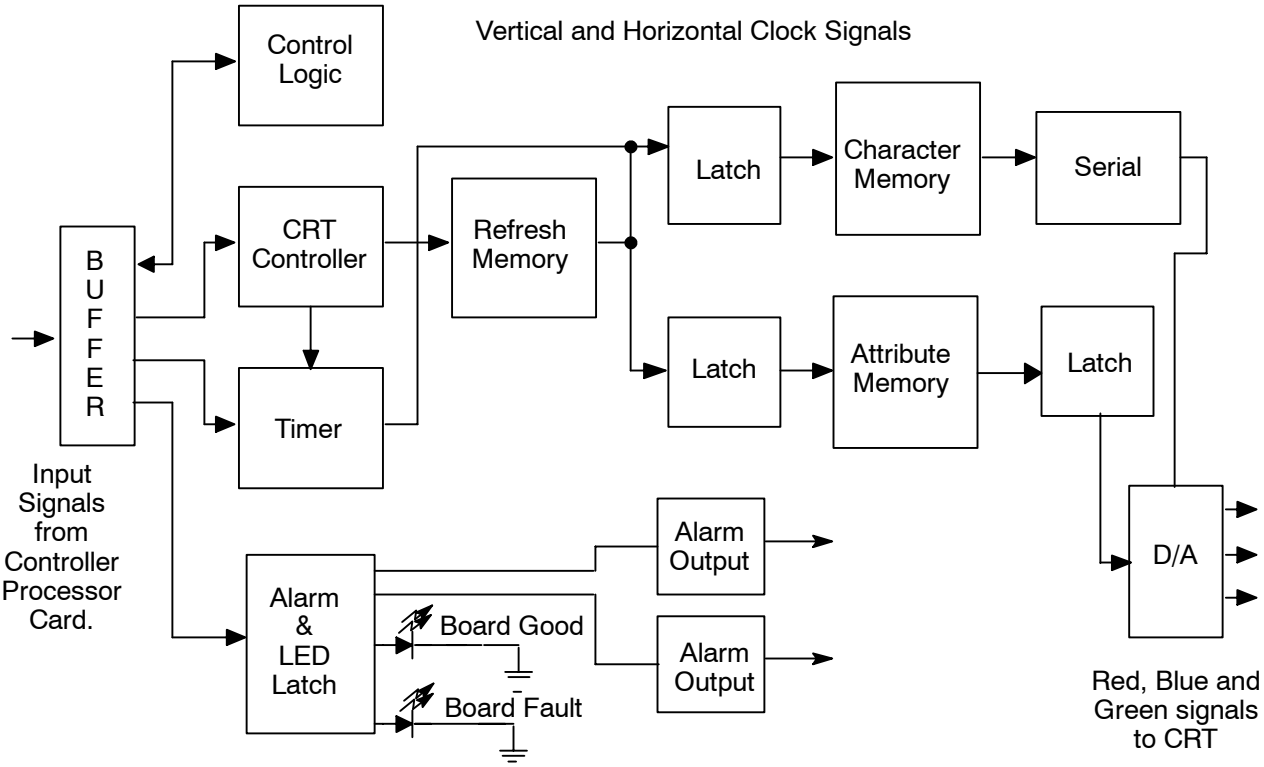


Figure 3.7.27. Character Graphics Video Generator Card Functional Diagram

Inputs to the Character Graphics Video Generator card include address lines and data lines from the Controller Processor card through the console motherboard. The input signals include the DTACK signal for synchronization, the SYSTEM CLOCK signal, and the RESET signal.

The output signals of the Character Graphics Video Generator card include red, blue, and green color signals and alarm contact signals. Color signals are sent to the CRT monitor and alarm contact signals are sent to the alarm output panel. Video information goes out with the red, blue, and green color signals. In addition, the sync signal is superimposed on the green color signal.

The horizontal and vertical clock signals for the CRT are created by the CRT controller, 68B45. The CRT controller sets horizontal and vertical timing for output signals and refresh memory addressing.

The RAM on the Character Graphics Video Generator card is divided into three sections: Refresh, Character, and Attribute. Refresh RAM output data is 16 bits wide, and gives data for each character location on the screen. Attribute and Character data load into RAM on power up. Attribute RAM provides a table for translations between color and pixel information. Character RAM contains the character font. The 8-bit output of the Character RAM is synchronized with the output from the Refresh RAM. This output contains two bits for each color, allowing 4 color intensities for each color.

The video output section includes three digital-to-analog converters (DACs) that convert digital signals into analog signals to drive the red, blue, and green electron guns.

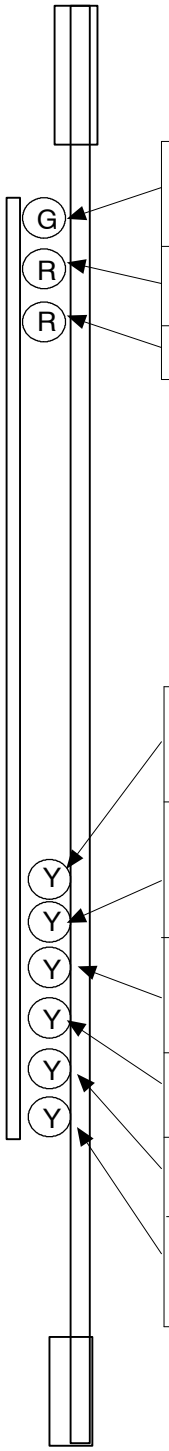
The card has a momentary contact switch to drive the CRT gun in order to help determine if the CRT is working.

External alarm contacts are driven from this card.

This is the first board checked by the processor after it has run its own diagnostics.

Character Graphics Video Generator LEDs

The Character Graphics Video Generator card has LEDs to indicate the card status. Figure 3.7.28 shows the LEDs.



DS1 (Green)	No faults are detected on the card. DS1 lights when the card completes power up diagnostics.
DS2 (Red)	Card fault. DS2 lights if the Video Generator Card fails power up diagnostics.
DS3 (Red)	Not used.
DS6 (Yellow)	Page 0 is active. Page 0 and page 1 store information for the CRT display. Depending on the amount of screen information, either DS6 or DS7 lights, or both DS6 and DS7 light.
DS7 (Yellow)	Page 1 is active. Page 0 and page 1 store information for the CRT display. Depending on the amount of screen information, either DS6 or DS7 lights, or both DS6 and DS7 light.
DS8 (Yellow)	Hardware alarm contact. The signal sent to light DS8 has also been sent to open or close the hardware alarm contact.
DS9 (Yellow)	Process alarm contact. The signal sent to light DS9 has also been sent to open or close the process alarm contact.
DS10 (Yellow)	Diagnostic routine is in progress during a power up procedure.
DS11 (Yellow)	Screen blank is active. On a normally functioning Character Graphics Video Generator Card, DS11 shows a slight but constant flicker.

Figure 3.7.28. Character Graphics Video Generator LEDs

Character Graphics Video Generator Fuse

Figure 3.7.29 shows the location of the fuse on the Character Graphics Video Generator. Table 3.7.16 shows fuse data.

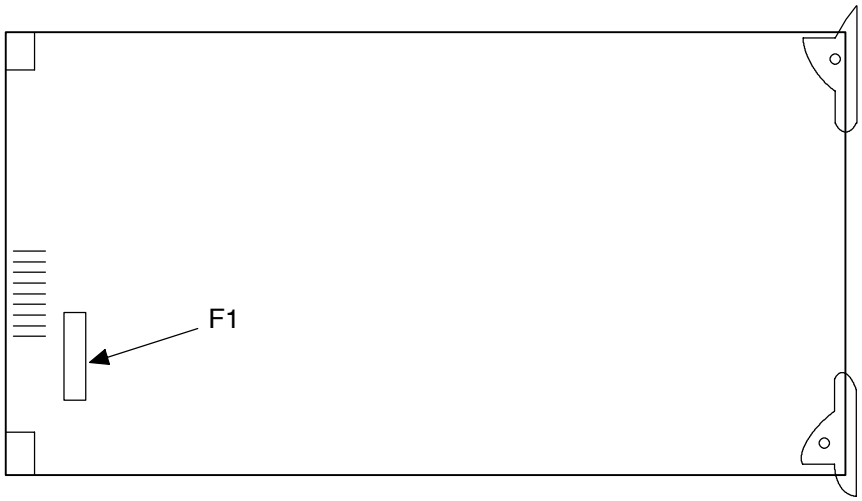


Figure 3.7.29. Character Graphics Video Generator Fuse Location

Table 3.7.16. Character Graphics Video Generator Fuse

Fuse	FRSI Part No.	Bussman Part No.	Littelfuse Part No.	Characteristics
F1	G09140–0032	MDL–2	312002	2A 250 V slow blow

Printer Interface

The Printer Interface card (1984–1011–0003) is marked “MINICONSOLE PRINTER INTERFACE” on the PWA. It has these functions:

- Real Time Clock (RTC) which keeps time for the system and is backed up by battery
- Battery backed RAM
- RS-232 Printer Interface which drives a printer capable of handling standard ASCII text
- RS-422 Interface for the Multitube Console

The card is used in these components:

- Multitube Command Console
- Command Console
- Basic Command Console
- MiniConsole
- Supervisory Computer Interface (SCI)

Table 3.7.17 shows parts replacement data.

Table 3.7.17. Printer Interface Parts Replacement

Part No.	Replaces	Characteristics
1984–1011–0001 1984–1011–0002		No RS-422 Interface
1984–1011–0003 1984–1011–0004	1984–1011–0001 1984–1011–0002	RS-422 Interface for Multitube Consoles

Figure 3.7.30 shows the functional diagram for the Printer Interface card.

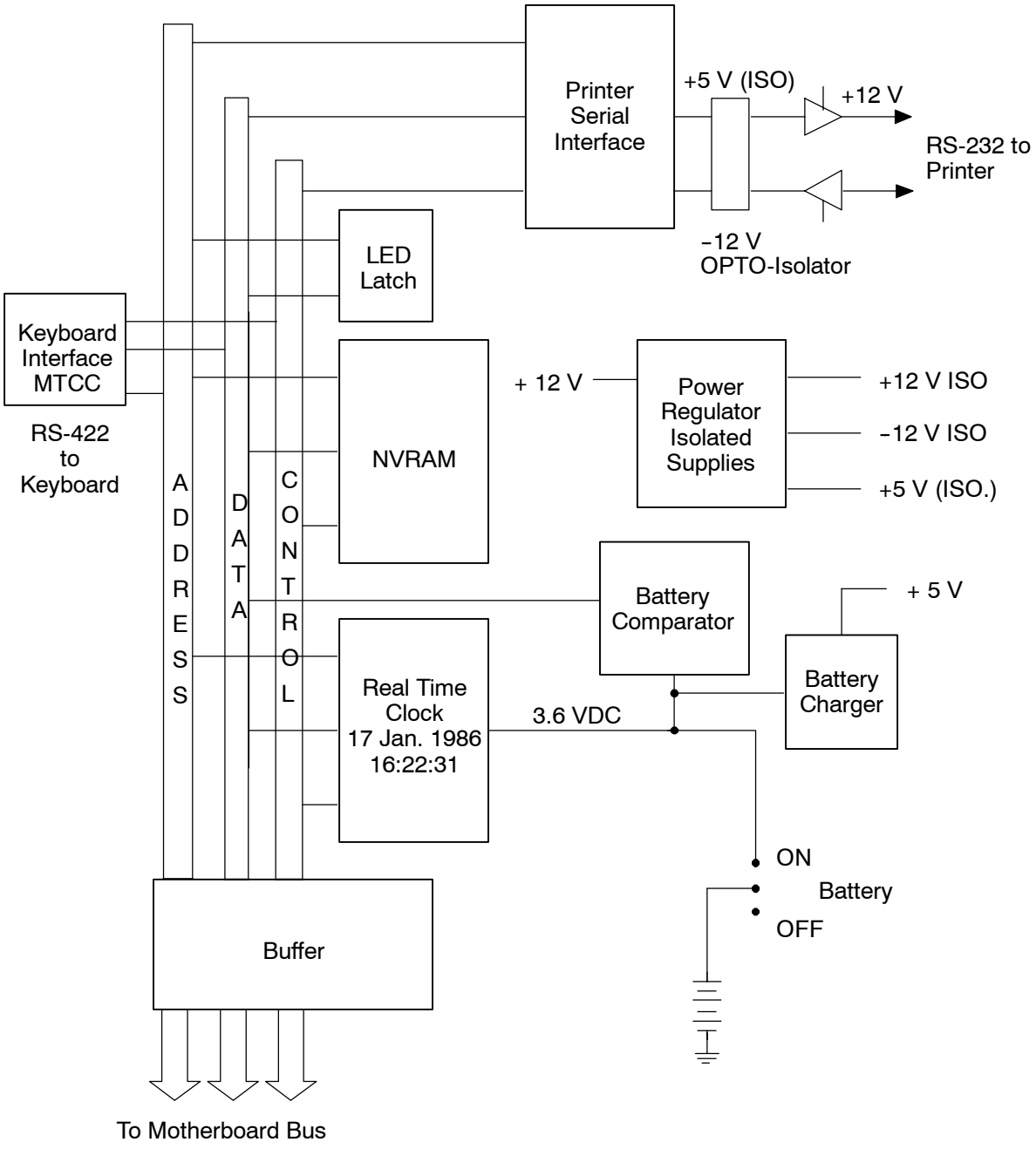


Figure 3.7.30. Printer Interface Functional Diagram

All operations of the Printer Interface card are handled by the Console Processor, so all data exchange on the bus is handled by the processor. LEDs are driven from a data latch to indicate card status. Another output from the latch is a software battery charge enable.

The 8 MHz clock is divided down and distributed. The Programmable Array Logic (PAL) decodes the addressing for the various addressable devices on the card. A data buffer puts the battery status indications on the data bus for the processor.

The card has 4 NVRAM chips to retain data if power is removed. Data to and from the EEROM is buffered for read and write.

NOTE: In current software revision levels, NVRAM is no longer used.

The Printer Interface card contains the serial interface, which transfers the parallel data and the printer format RS-232 data. All data on and off the card are isolated by optical isolators.

The consoles support any RS-232 serial communications printer that uses X-On/X-Off or data terminal ready (DTR) signals to indicate when the printer buffer is full. If the printer does not use X-On/X-Off or DTR, select a slower baud rate. Compatible printers should have eight bits, no parity, no automatic line feed and one stop bit.

The real time clock (RTC) generates:

- Seconds
- Minutes
- Hours
- Day of the Week
- Day of the Month
- Month
- Year (including Leap Year)

The RTC is backed up by three Nicad battery cells. A jumper that disables power during shipping must be repositioned before the card is placed in service. While in service, the batteries are charged at a constant 7 mA rate.

Data is buffered both in and out of the RTC.

There is a port for the Keyboard Interface board to communicate with the console on this card. Only the Multitube consoles interface on this card; all others interface on the OI processor.

Printer Interface LEDs

Printer Interface cards -0001 and -0002 (those without the RS-422 interface) have seven LEDs to indicate card status. Figure 3.7.31 shows the LEDs of cards -0001 and -0002.

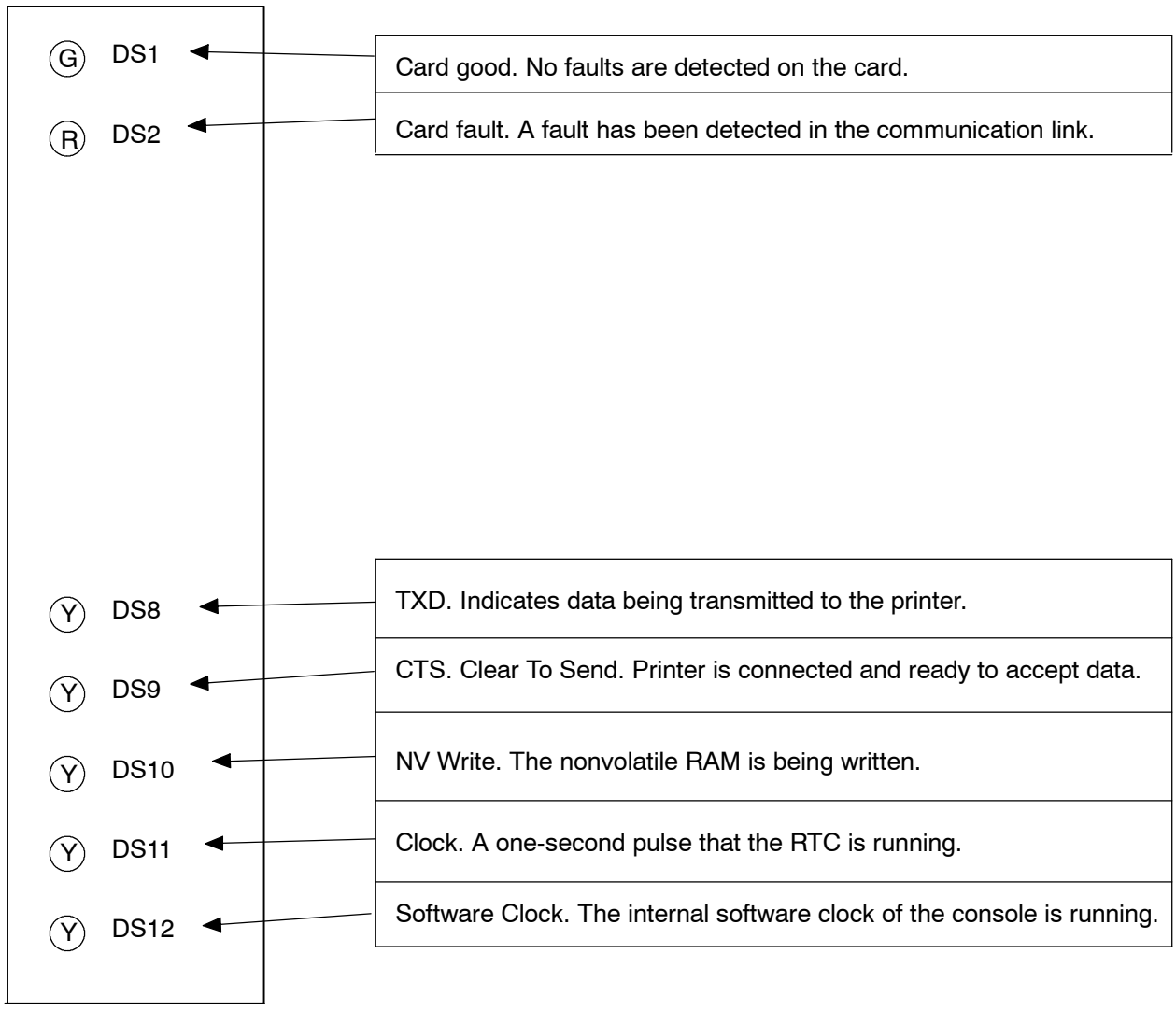

G DS1
Card good. No faults are detected on the card.
R DS2
Card fault. A fault has been detected in the communication link.
Y DS8
TXD. Indicates data being transmitted to the printer.
Y DS9
CTS. Clear To Send. Printer is connected and ready to accept data.
Y DS10
NV Write. The nonvolatile RAM is being written.
Y DS11
Clock. A one-second pulse that the RTC is running.
Y DS12
Software Clock. The internal software clock of the console is running.

Figure 3.7.31. Printer Interface Card -0001, -0002 (Without RS-422 Interface) LEDs

Printer Interface cards -0003 and -0004 (those with the RS-422 interface) have nine LEDs to indicate card status. Figure 3.7.32 shows the LEDs of cards -0003 and -0004.

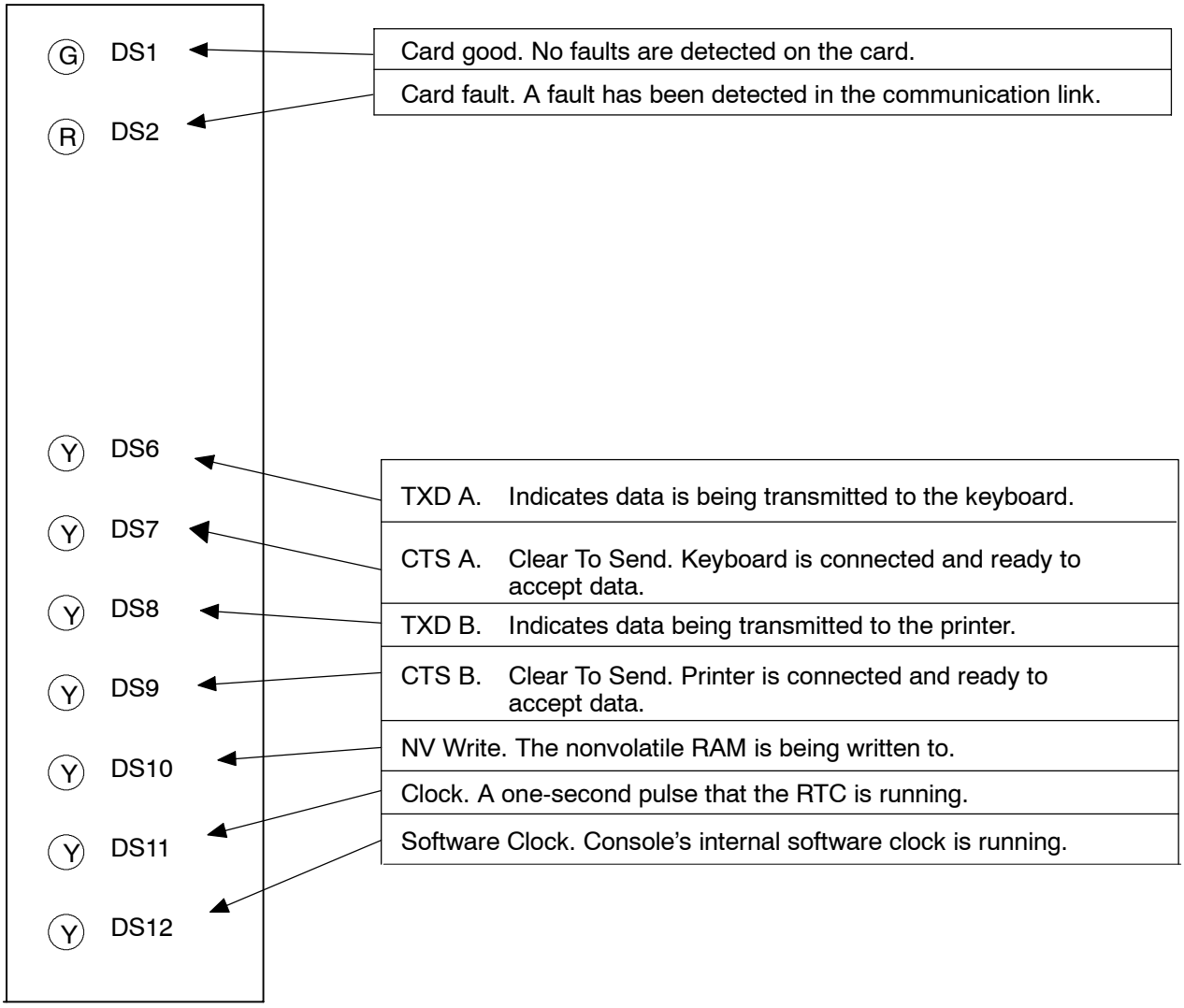

G DS1
R DS2
Y DS6
Y DS7
Y DS8
Y DS9
Y DS10
Y DS11
Y DS12
Card good. No faults are detected on the card.
Card fault. A fault has been detected in the communication link.
TXD A. Indicates data is being transmitted to the keyboard.
CTS A. Clear To Send. Keyboard is connected and ready to accept data.
TXD B. Indicates data being transmitted to the printer.
CTS B. Clear To Send. Printer is connected and ready to accept data.
NV Write. The nonvolatile RAM is being written to.
Clock. A one-second pulse that the RTC is running.
Software Clock. Console's internal software clock is running.

Figure 3.7.32. Printer Interface Card -0003, -0004 (With RS-422 interface) LEDs

Printer Interface Jumpers

Figure 3.7.33 shows the location of the battery jumper on the Printer Interface. Table 3.7.18 gives the jumper values.

The Printer Interface battery jumper must be in the ON (1–2) position when the card is installed in a console, and in the OFF (2–3) position when the card is shipped or stored. The battery jumper is in the OFF position when the card is shipped from stock. All other jumpers are factory set and should not be moved.

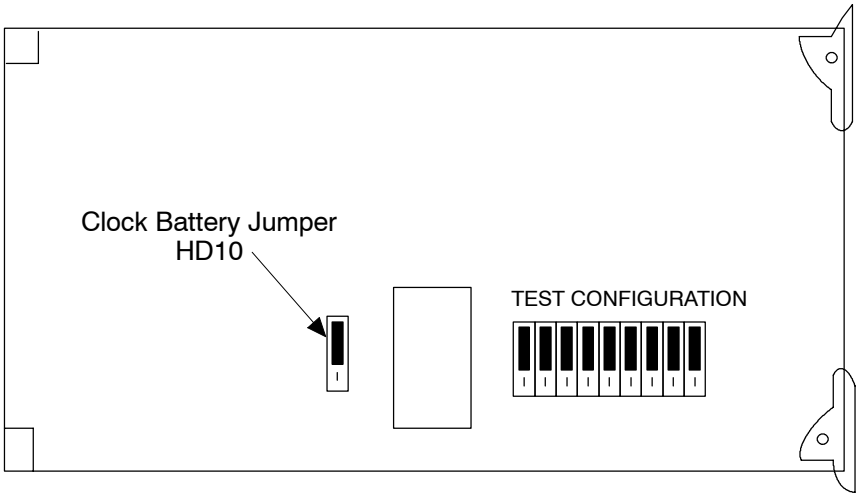


Figure 3.7.33. Printer Interface Jumper Locations

Table 3.7.18. Printer Interface Jumper Placement

Jumper	Position	Function
HD10	1–2	Clock battery connected (Operating position)
	2–3	Clock battery disconnected (Storage position)
HD1–HD6	M	Configured as Modem (Normal position)
HD7–HD9	N	Test disabled (Normal position)

SCSI (Small Computer System Interface)

The Small Computer System Interface (SCSI) card, in the OI Card Cage, provides the interface to hard disks, magnetic tape drives, floppy disks, optical disks, printers, and local area networks. These versions are in use:

- 1984-3301-0001 marked “SCSI BOARD 2” on the PWA.
- 1984-1140-0001 and -0004 marked “OI SCSI HOST ADAPTER” on the PWA.

The SCSI card performs the following functions:

- Allows alarm messages to be sent from console to console over the SCSI interface bus.
- Provides data transfer from mass storage devices (tapes and disks) to the OI Processor Card.
- Provides the host computer with peripheral device independence by translating SCSI commands into disk or tape commands.

Table 3.7.19 shows parts replacement data.

Table 3.7.19. SCSI Card Parts Replacement

Part Number	Replaces	Characteristics
1984-3301-000x	1984-1140-0001 **NOTE:** You cannot mix -3301 and -1140 boards in a Multitube console.	Requires OI 68040 Processor with a minimum boot ROM of 10.08. **NOTE:** See the Software Release Notes for the current boot ROM to be used with your version of software.
1984-1140-0004	1984-1140-0001	Cannot be used with a -3301 board in a Multitube console.
1984-1140-0001	Itself only	Cannot be used with a -3301 board in a Multitube console.

NOTE: With a disk-only console, SCSI termination is required. Use 1984-3301-0001 with the proper termination jumper settings (Table 3.7.21), or use 1984-1140-0003, which has termination resistors.

Figure 3.7.34 is the functional diagram of the SCSI Board 2.

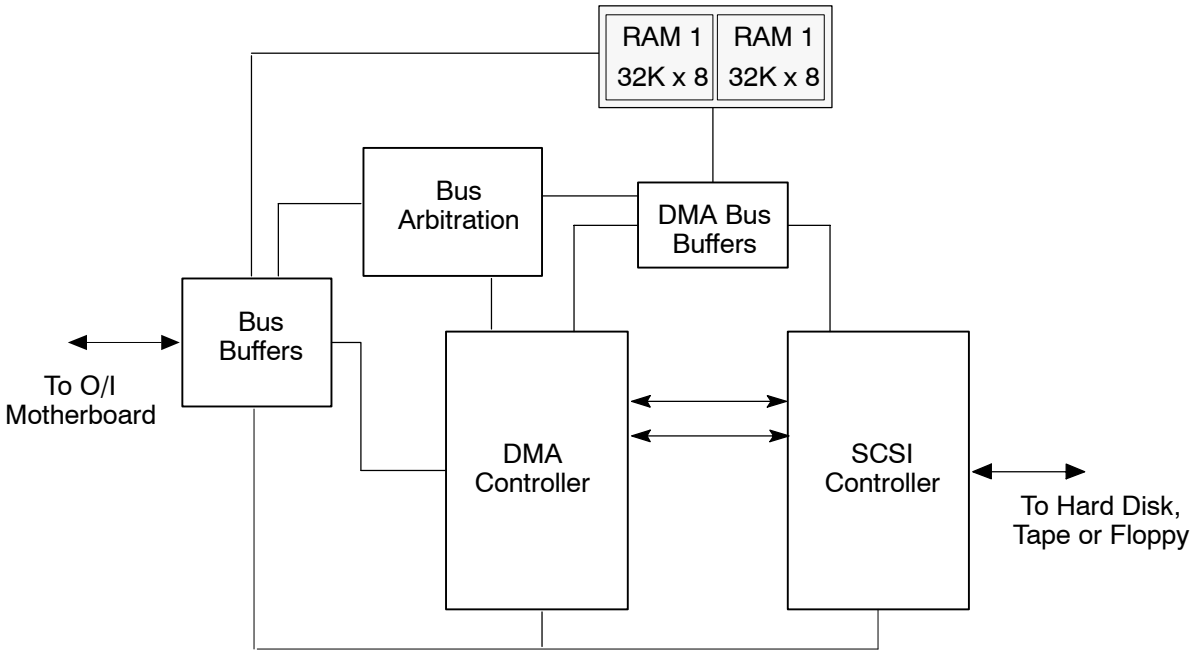


Figure 3.7.34. SCSI Board 2 Functional Diagram

Figure 3.7.35 shows a functional diagram of the OI SCSI Host Adapter.

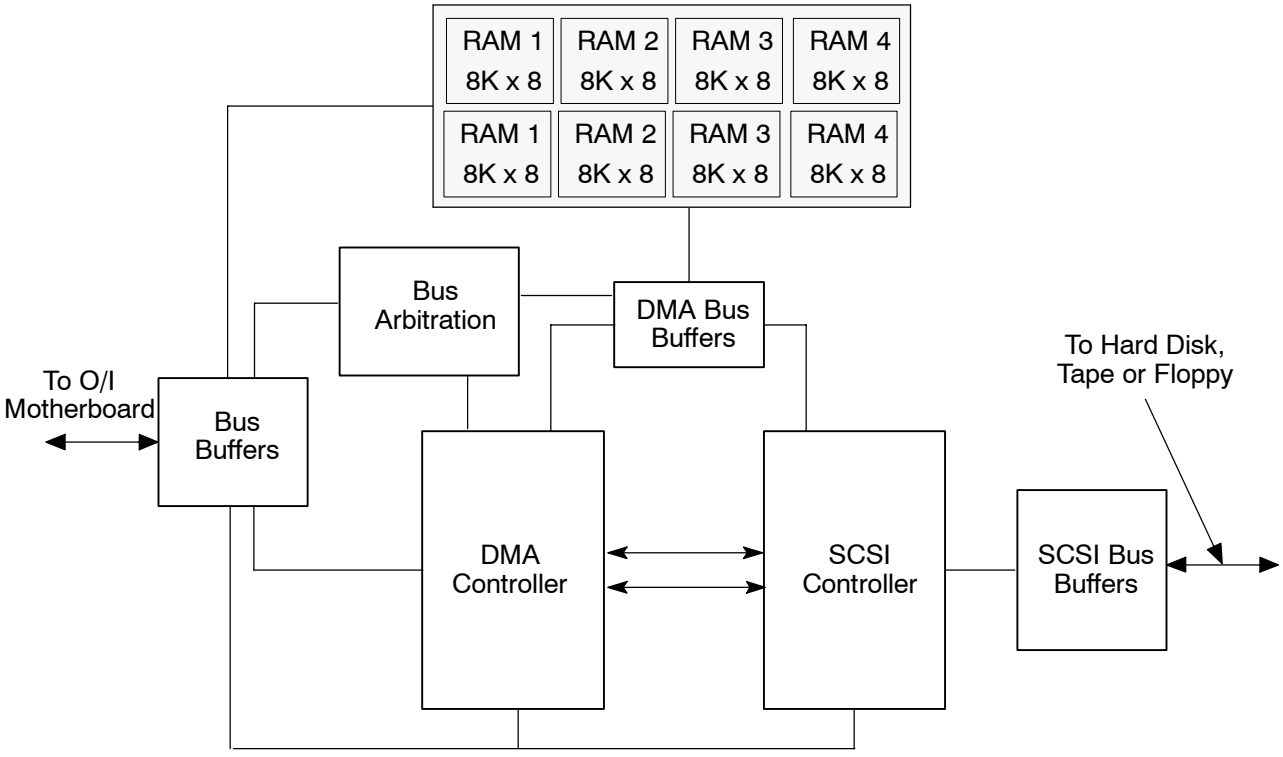


Figure 3.7.35. OI SCSI Host Adapter Functional Diagram

In a Multitube console, one of the Multitube Card Cages acts as the SCSI master. A 50-pin ribbon cable and a power cable with +5 VDC and +12 VDC lines connect the SCSI card to devices such as a disk or a tape drive.

The SCSI card has two controllers: a direct memory access controller (DMAC) and a SCSI controller. Address, data, and timing lines are sent across the motherboard under the direction of the OI Processor card. The DMAC handles the data transfer between the SCSI card and static RAM. The DMAC transfers bytes of memory to or from sequential memory locations in 16-bit words.

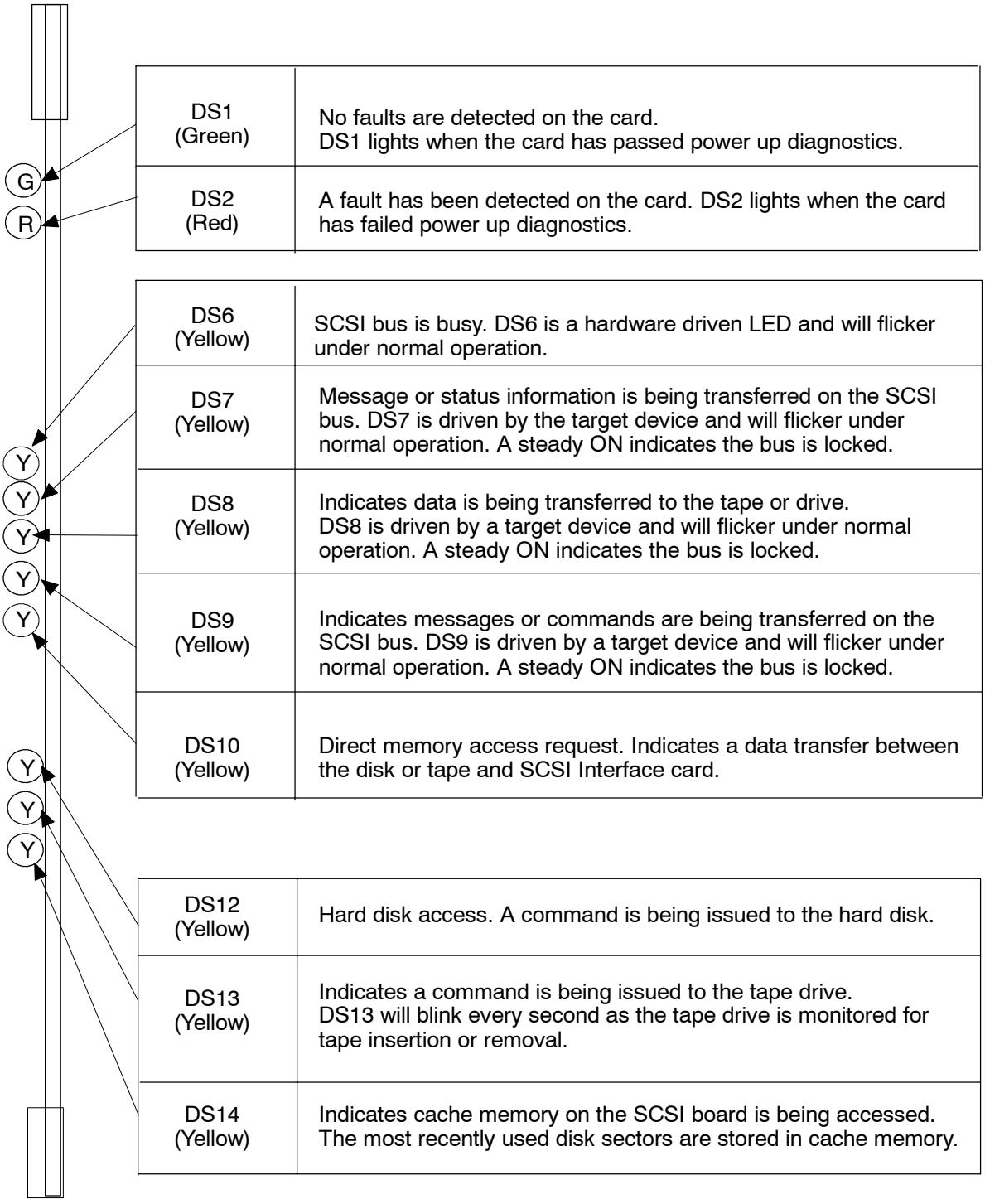
Data from the SCSI card in the Console Card cage goes on the SCSI bus. From the SCSI bus, information goes to a SCSI board mounted in the tape or disk drive. Each device on the SCSI bus has its own SCSI bus address. The disk and tape drives are considered separate from the console hardware although disk and tape drives are powered by the SCSI master. Each SCSI card has its own SCSI address and is to be considered an equal device.

The synchronous bus has arbitration to assure that the two controllers, DMAC and SCSI, cannot be enabled at the same time. Bus arbitration occurs between the OI Processor card, SCSI controller and the DMAC. Either the SCSI controller or the DMAC may request control of the synchronous bus. When control is given to one device, another device cannot access the bus until the current request is completed.

A decoder selects one of the static RAM chips used for buffer memory storage of messages to and from the SCSI mass storage devices.

SCSI LEDs

Figure 3.7.36 shows the LEDs for the SCSI card.



DS1 (Green)	No faults are detected on the card. DS1 lights when the card has passed power up diagnostics.
DS2 (Red)	A fault has been detected on the card. DS2 lights when the card has failed power up diagnostics.

DS6 (Yellow)	SCSI bus is busy. DS6 is a hardware driven LED and will flicker under normal operation.
DS7 (Yellow)	Message or status information is being transferred on the SCSI bus. DS7 is driven by the target device and will flicker under normal operation. A steady ON indicates the bus is locked.
DS8 (Yellow)	Indicates data is being transferred to the tape or drive. DS8 is driven by a target device and will flicker under normal operation. A steady ON indicates the bus is locked.
DS9 (Yellow)	Indicates messages or commands are being transferred on the SCSI bus. DS9 is driven by a target device and will flicker under normal operation. A steady ON indicates the bus is locked.
DS10 (Yellow)	Direct memory access request. Indicates a data transfer between the disk or tape and SCSI Interface card.

DS12 (Yellow)	Hard disk access. A command is being issued to the hard disk.
DS13 (Yellow)	Indicates a command is being issued to the tape drive. DS13 will blink every second as the tape drive is monitored for tape insertion or removal.
DS14 (Yellow)	Indicates cache memory on the SCSI board is being accessed. The most recently used disk sectors are stored in cache memory.

Figure 3.7.36. SCSI Card LEDs

SCSI Jumpers

The boards differ in jumper usage.

NOTE: The SCSI address is independent of the PeerWay node address of the console and card cage.

1984-3301-000x SCSI Board 2

This card has two sets of jumpers, one sets the SCSI ID and one enables or disables the bus active terminators.

Figure 3.7.37 shows the jumper locations on the card.

Table 3.7.20 shows the SCSI ID jumper settings.

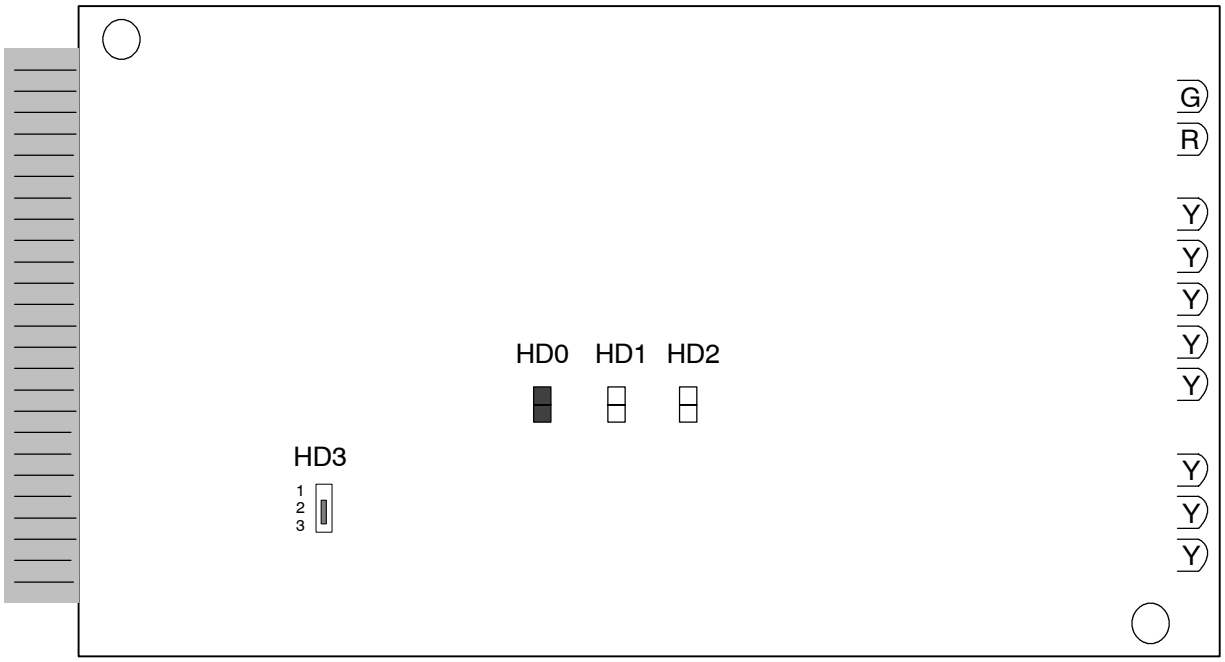


Figure 3.7.37. SCSI Board 2 (1984-3301-000x) Jumper Locations

Table 3.7.20. SCSI Board 2 (1984-3301-000x) ID Jumper Setting

SCSI Device ID	Put Jumper On	Used For
0	HD0	Card Cage A
1	HD1	Card Cage B
2	HD2	Card Cage C

Bus termination is used only when the card is at the physical end of the bus and there is only one other terminated device on the bus. Table 3.7.21 shows the SCSI Bus Terminator jumper settings.

NOTE: With a disk-only console, the bus termination jumper on this board must be enabled.

Table 3.7.21. SCSI Board 2 (1984-3301-000x) Bus Terminator Jumper Setting

HD3	Action
1-2	Enabled (Disk-only Console)
2-3	Disabled (Normal setting)

1984-1140-0001 OI SCSI Host Adapter

This card has two sets of jumpers to select addressing. The SCSI DEVICE ID jumpers set the data bus to communicate by using the correct ID. SCSI BUS ID jumpers tell the SCSI controller communications chip its address. Figure 3.7.38 shows the jumper locations on the console SCSI card.

Set both jumpers at address 2 if the card is installed in a Pedestal Command Console.

NOTE: Both sets of jumpers must be set to the same address.

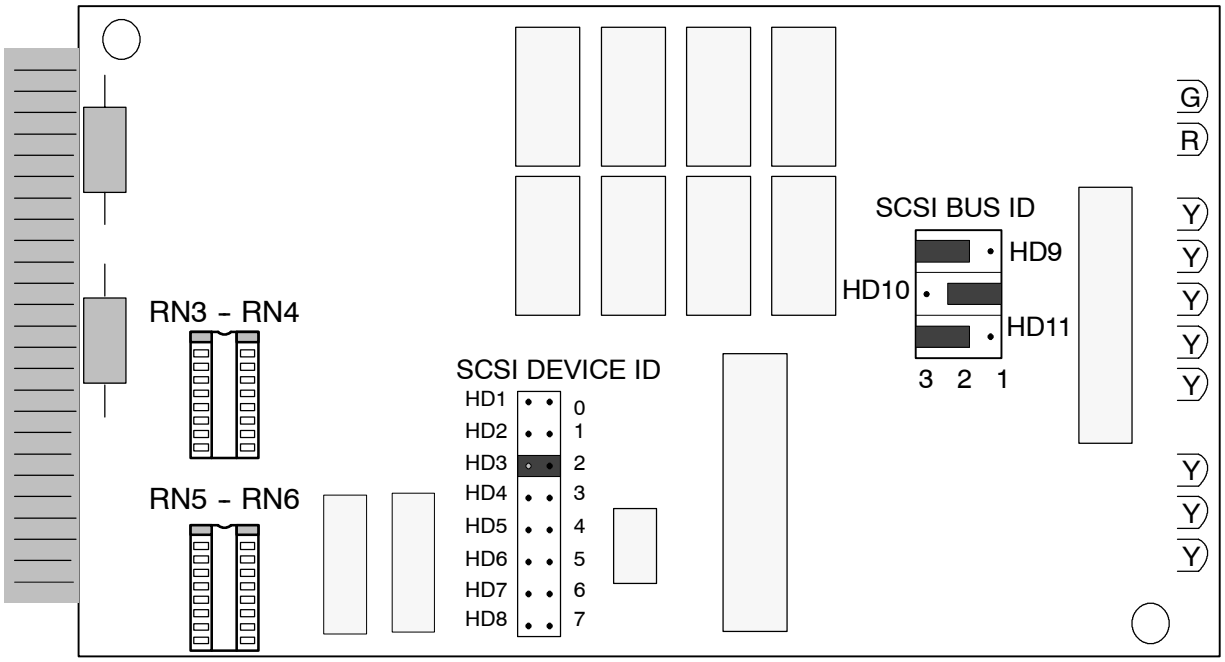


Figure 3.7.38. OI SCSI Host Adapter (1984-1140-0001) Jumper Locations

Table 3.7.22 shows positions of the SCSI Device ID jumper. Note that only one jumper is used to specify the device address.

Table 3.7.22. OI SCSI Host Adapter (1984-1140-000x) Device ID Jumper

SCSI Device ID	Put Jumper On	Used For
0	HD1	Card Cage A
1	HD2	Card Cage B or Command Console
2	HD3	Card Cage C
3-7	HD4-HD8	These device IDs are not used in Console Card Cages

Table 3.7.23 shows positions of the three SCSI card Address jumpers.

Table 3.7.23. OI SCSI Host Adapter (1984-1140-000x) Address Jumpers

SCSI Bus Address	HD9	HD10	HD11	Used For
0	2-3	2-3	2-3	Card Cage A
1	2-3	2-3	1-2	Card Cage B or Command Console
2	2-3	1-2	2-3	Card Cage C
3	2-3	1-2	1-2	Not used
4	1-2	2-3	2-3	Not used
5	1-2	2-3	1-2	Not used
6	1-2	1-2	2-3	Not used
7	1-2	1-2	1-2	Not used

OI Nonvolatile Memory

The OI Nonvolatile (NV) Memory is used in the Supervisory Computer Interface (SCI), Highway Interface Adapter (HIA), Rosemount Factory Interface (RFI), and the Diogenes Interface. There are two versions:

- OI NV RAM using battery-backed RAM:
  - 1984-1547-0001 marked “OI NV RAM” on the PWA.
- OI Bubble Memory using bubble memory modules:
  - 1984-1147-0001 marked “OI BUBBLE MEMORY” on the PWA.
  - 1984-1167-0002 marked “OI BUBBLE MEMORY SC” on the PWA.

The card may be referred to by a name associated the unit using it, such as “HIA Bubble Memory”, and “SCI Bubble Memory”. The term “bubble” is often used for a RAM OI NV Memory.

The OI Nonvolatile Memory provides:

- NV memory for the OI Processor.
- RS-232 communications interface to a host computer or other device
- RS-422 communications interface to a host computer or other device
- Real Time Clock (RTC)

Table 3.7.24 gives parts replacement data for the OI Nonvolatile Memory. The OI NV RAM has much higher data transfer rates between the OI Processor and the OI NV Memory, and may have a larger memory. There may be system restrictions on replacing a RAM card with a Bubble card.

Table 3.7.24. OI NV Memory Replacement Data

Part No.	Replaces	Characteristics
1984-1547-0001 -0002	1984-1147-0001 1984-1167-0002	256K RAM -0001 has X.25 -0002 has X.25 disabled
1984-1547-0003 -0004	1984-1147-0001 1984-1167-0002	512K RAM -0003 has X.25 -0004 has X.25 disabled
1984-1167-0001 -0002	1984-1147-0001	256K Bubble Memory -0001 has X.25 -0002 has X.25 disabled
1984-1147-0001	-	Original 256K Bubble Memory Does not have X.25 capability

OI Bubble Memory

The OI Bubble Memory uses bubble memory modules for NV memory service. There are two part numbers:

- 1984-1147-0001 marked “OI BUBBLE MEMORY” on the PWA.
- 1984-1167-0002 marked “OI BUBBLE MEMORY SC” on the PWA.

See Table 3.7.24 (OI NV Memory Replacement Data) for OI Bubble Memory replacement data.

The OI Bubble Memory card is composed of:

- Bus Arbitration control
- Direct Memory Address (DMA) Controller
- 8K x 8 Static RAM
- Serial Communications Controller
- Magnetic Bubble Memory
- Real Time Clock
- Read and Write Latches

Figure 3.7.39 is a block diagram of the OI Bubble Memory card.

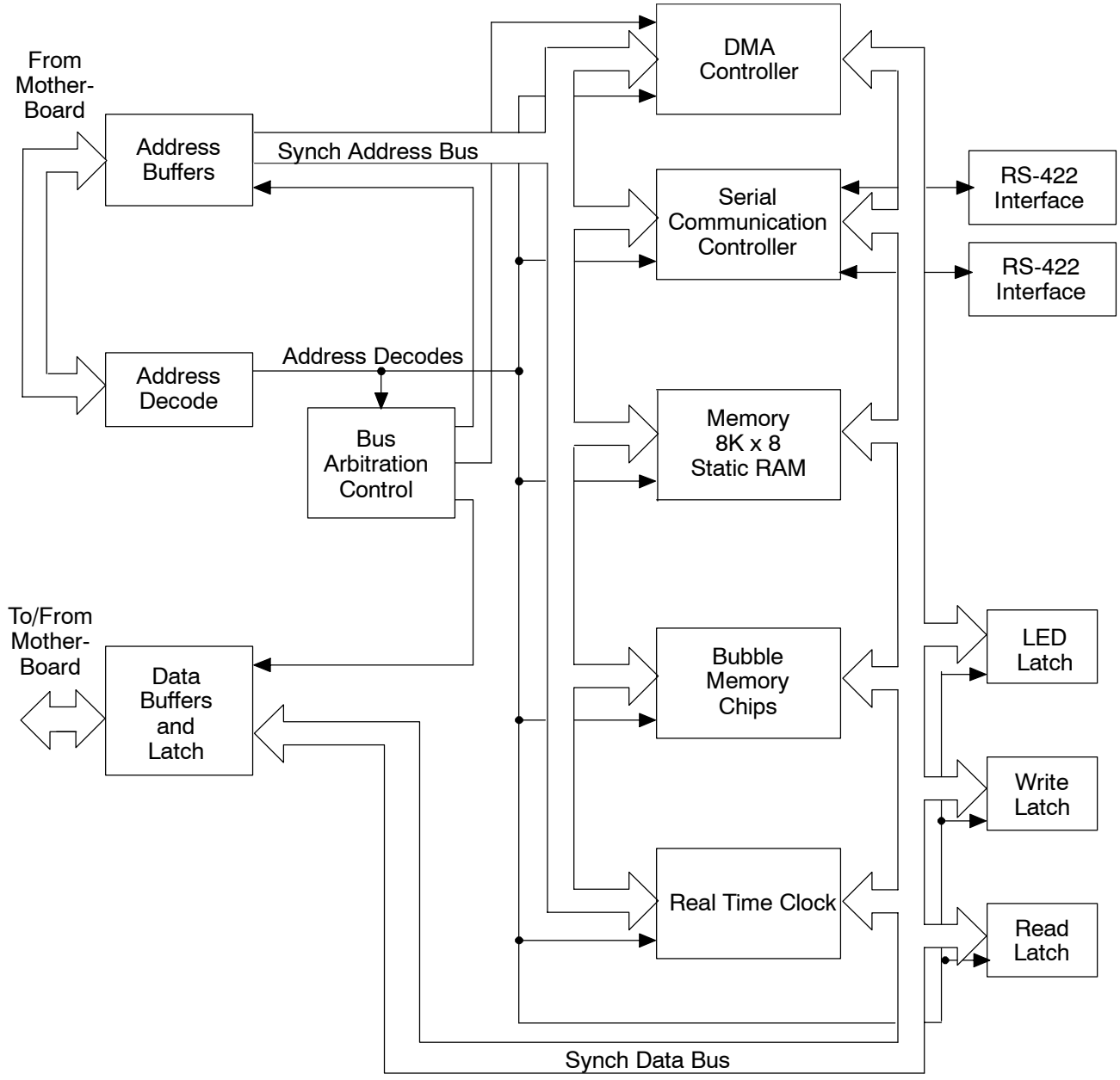


Figure 3.7.39. OI Bubble Memory Block Diagram

Bus Arbitration Control arbitrates access between the OI Processor and the DMAC. The DMAC always has first access to the bus. The DMAC is used in data transfer with the Bubble Memory and the Serial Communication Controller because of their high data transfer rates. The Bubble Memory consists of bubble chips and control circuitry.

There are two serial communications channels:

- Channel A is an RS-422 communications port.
- Channel B is an RS-232 port.

Only one channel is used at a time. The choice is made by software from the Operator Console.

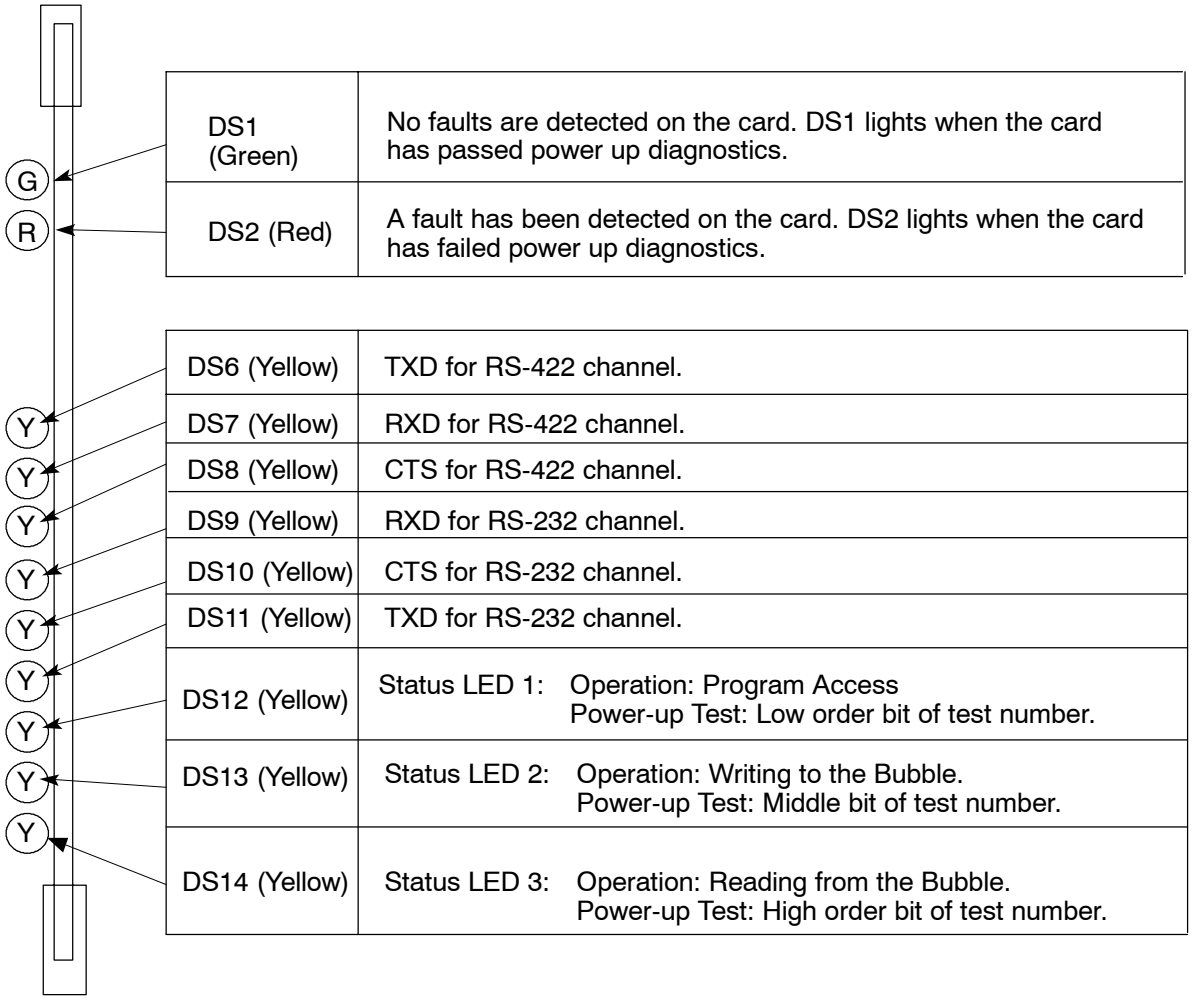
Jumpers are used to configure the communications ports. The Baud rate on the communications channel is set by software. Other jumpers allow configuration as a terminal (clock supplied externally) or as a modem (this card supplies the clock) and to select a loopback test. The loopback jumpers connect *transmit* with *receive* data and *request-to-send* with *clear-to-send* signals. Three LEDs monitor each communications channel.

The Real Time Clock supplies real time clock services for the OI Processor card. These include periodic interrupts, time and date keeping, and 50 bytes of battery backed RAM. The clock is backed up by a nicad battery and an associated charging circuit. The battery provides for continuation of the clock readings over power failures and for times when the card may be removed from the card cage. Jumpers are provided to disable the battery when the card will be unused for a period of more than a few hours.

The 8K x 8 Static RAM is accessible by both the OI Processor and the DMA Controller. The Read Latch has a battery status line and provides for software differentiation between the two generations of OI Bubble Memory boards. The Write Latch is used for bubble memory testing. The LED Latch drives the status LEDs.

OI Bubble Memory LEDs

Figure 3.7.40 shows the LEDs on the OI Bubble NV Memory.



DS1 (Green)	No faults are detected on the card. DS1 lights when the card has passed power up diagnostics.
DS2 (Red)	A fault has been detected on the card. DS2 lights when the card has failed power up diagnostics.

DS6 (Yellow)	TXD for RS-422 channel.
DS7 (Yellow)	RXD for RS-422 channel.
DS8 (Yellow)	CTS for RS-422 channel.
DS9 (Yellow)	RXD for RS-232 channel.
DS10 (Yellow)	CTS for RS-232 channel.
DS11 (Yellow)	TXD for RS-232 channel.
DS12 (Yellow)	Status LED 1: Operation: Program Access Power-up Test: Low order bit of test number.
DS13 (Yellow)	Status LED 2: Operation: Writing to the Bubble. Power-up Test: Middle bit of test number.
DS14 (Yellow)	Status LED 3: Operation: Reading from the Bubble. Power-up Test: High order bit of test number.

Figure 3.7.40. OI Bubble NV Memory LEDs

OI Bubble Memory LED Sequences

In normal operation, the green LED (DS1) is ON. DS6 through DS8 flash for RS-422 communications. DS9 through DS11 flash for RS-232 communications. DS12 through DS14 flash as reads and writes are made to the RAM.

The boot sequence has the red LED (DS2) ON with the three yellow status LEDs (DS12, DS13, DS14) flashing. At the end of a successful power-up test, the green LED lights. If the power-up test fails, the red LED stays ON and the failed test will be displayed in the status LEDs as indicated in Table 3.7.25. Note that the status of DS12 is not usually significant.

Table 3.7.25. OI Bubble LED Sequences

Status LEDs (DS12, 13, 14)	Failed Test
-- OFF OFF	Unable to initialize.
-- OFF **ON**	Write failure.
-- **ON** OFF	Read failure.
-- **ON** **ON**	Read or write failure.
ON **ON** **ON**	Both 30 VDC power supplies bad.

OI Bubble Memory Jumpers

Figure 3.7.41 shows jumper locations on the OI Bubble Memory card. Table 3.7.26 gives jumper values. Set the jumper for the Real Time Clock battery (HD1) to OFF (2–3) if you remove the card for more than a few hours.

The Board Address Decode jumper (HD19) is used to distinguish between two OI NV RAM cards inserted in the card cage at the same time. You must jumper one as “DOWNLOAD”, the other as “NORMAL” so data in the “NORMAL” card may be restored.

See Chapter 10: Troubleshooting Consoles for the detailed restoration procedure.

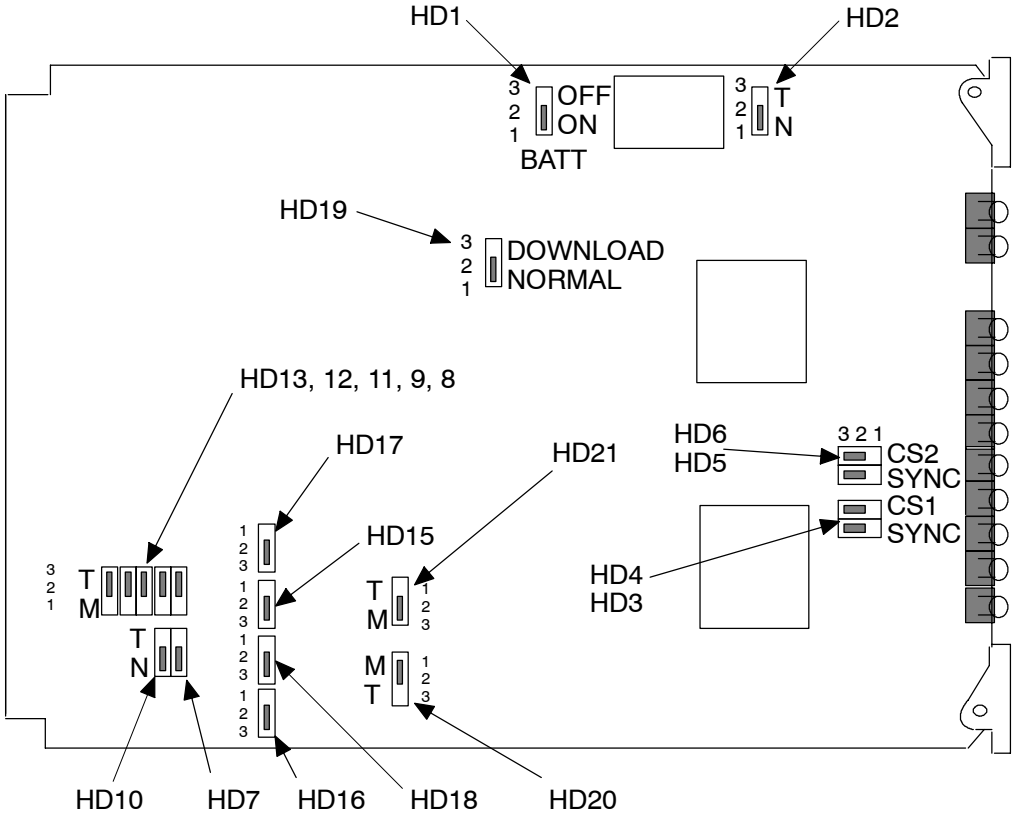


Figure 3.7.41. OI Bubble Memory Jumpers

Table 3.7.26. OI Bubble Jumper Values

Jumper	Value	Purpose
HD1 (BATT)	**ON**	Real Time Clock battery connected
	OFF	Real Time Clock battery disconnected
HD2 (BOOT SWAP)	T	No longer used by software
	N	No longer used by software
HD3 (SYNC)	1–2	Bubble test (Factory use only)
	2–3	Normal operation
HD4 (CS1)	1–2	Bubble test (Factory use only)
	2–3	Normal operation
HD5 (SYNC)	1–2	Bubble test (Factory use only)
	2–3	Normal operation
HD6 (CS2)	1–2	Bubble test (Factory use only)
	2–3	Normal operation
HD7, HD10	N	Normal Communications (RS-232)
	T	Communications Loopback Test (RS-232)
HD8, 9, 11, 12, 13	M	Function as a Modem (RS-232)
	T	Function as a Terminal (RS-232)
HD14	–	Not Used
HD15, 16, 17, 18	T	Communications Loopback Test (RS-422)
	N	Normal Communications (RS-422)
HD19	DOWNLOAD	Address this board as Secondary (See text)
	NORMAL	Address this board as Primary (See text)
HD20	M	Function as a Modem (RS-422)
	T	Function as a Terminal (RS-422)
HD21	T	Function as a Terminal (RS-422)
	M	Function as a Modem (RS-422)

OI NV RAM

The OI NV RAM uses battery backed RAM as the storage medium. This allows much faster data transfer between the OI NV RAM and the OI Processor and also provides an optional larger memory. The part number is 1984-1547-000x. It is marked “OI NV RAM” on the PWA.

See Table 3.7.24 (OI NV Memory Replacement Data) for OI NV RAM parts replacement data.

The OI NV RAM duplicates all OI Bubble Memory functions and is a fully qualified replacement for the bubble card. A RAM card reads and writes faster than the bubble card and may have twice the memory, so in some cases a bubble card cannot replace a RAM card.

The OI NV RAM card consists of:

- Bus Arbitration Control
- DMA Controller
- 8K x 8 Communication Static RAM buffer
- Serial Communication Controller
- Battery Backed Static RAM
- Real Time Clock
- Diagnostic Latches

Figure 3.7.42 is a block diagram of the OI NV RAM.

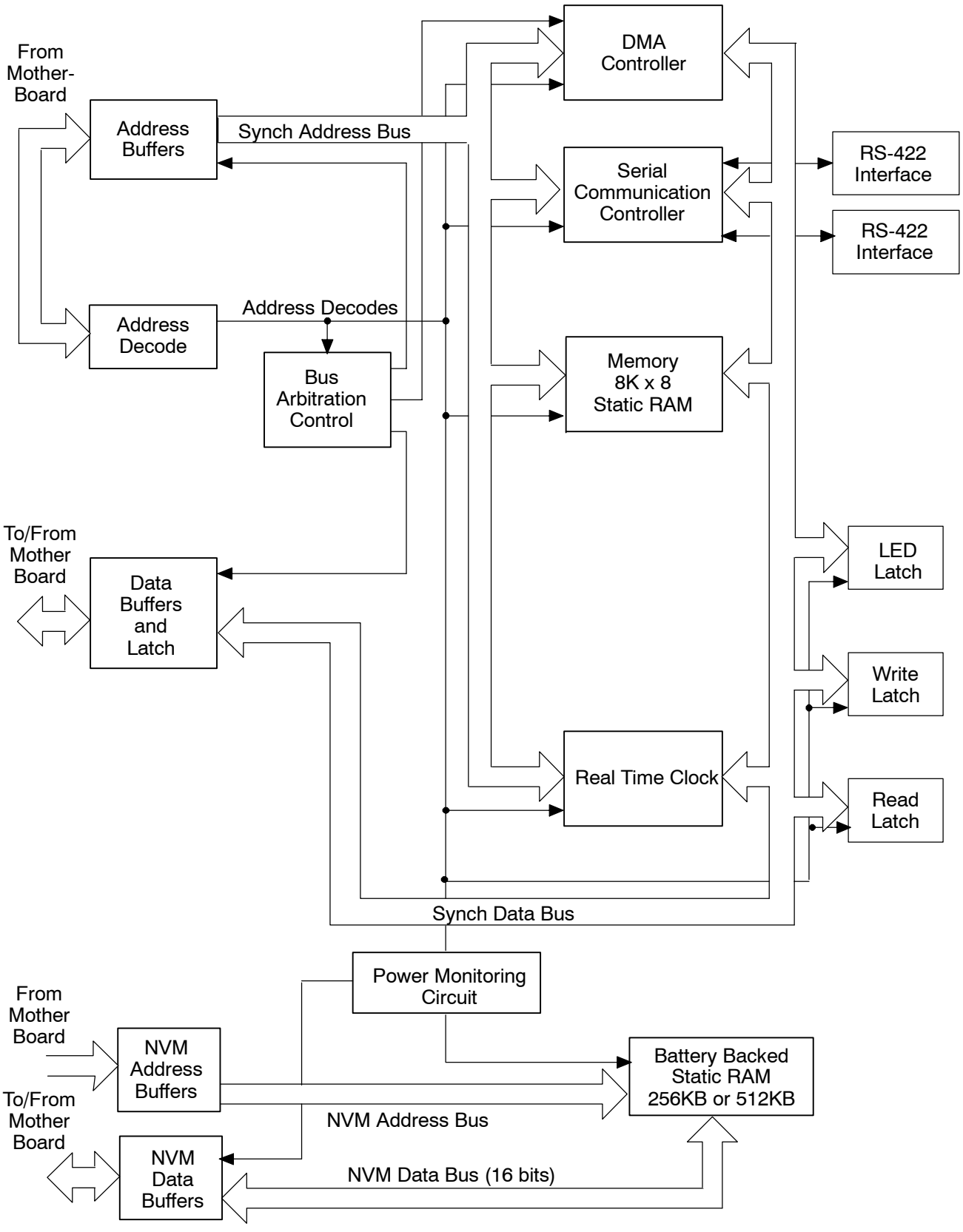


Figure 3.7.42. OI NV RAM Memory Block Diagram

Bus Arbitration Control: Most addresses are the same for the bubble and RAM cards. The OI processor senses the type of nonvolatile memory in use and adjusts addresses as required. Bus Arbitration Control arbitrates access between the OI processor and the DMAC.

DMAC: The DMAC always has first access to the bus. The DMAC is used in data transfers between the Serial Communication Controller and the Communication Static RAM. This frees the OI processor for other tasks.

8K x 8 Communication Static RAM Buffer: The 8K x 8 Static RAM is accessible by the OI Processor.

Diagnostic Latches: The Read Latch has battery status lines and configuration information. The Write Latch changes pages of the NV RAM and starts battery tests. The LED Latch drives the status LEDs.

Serial Communication Controller: There are two serial communications channels:

- Channel A is an RS-422 communications port.
- Channel B is an RS-232 port.

Only one channel may be used at a time. The choice is made from the Operator's console (by software). Jumpers are used to configure the communications ports. The Baud rate on the communications channel is set by software. Other jumpers allow configuration as a terminal or as a modem. Jumpers are also used to select a loopback test. The loopback jumpers directly connect transmit with *receive* data and *request-to-send* with *clear-to-send* signals. Three LEDs monitor the activity of each communications channel.

Real Time Clock: The Real Time Clock supplies real time clock services for the OI Processor card including time and date, periodic interrupts, and 50 bytes of battery backed RAM. The clock is backed up by the battery control circuit. The battery provides for continuation of the clock readings over power failures and for times when the card may be removed from the card cage.

Battery Backed RAM: The battery backed RAM (BRAM) consists of the RAM chips and required control and battery backup circuits. It is accessed only by the OI processor over a dedicated NVRAM bus. Figure 3.7.43 shows the battery control circuit.

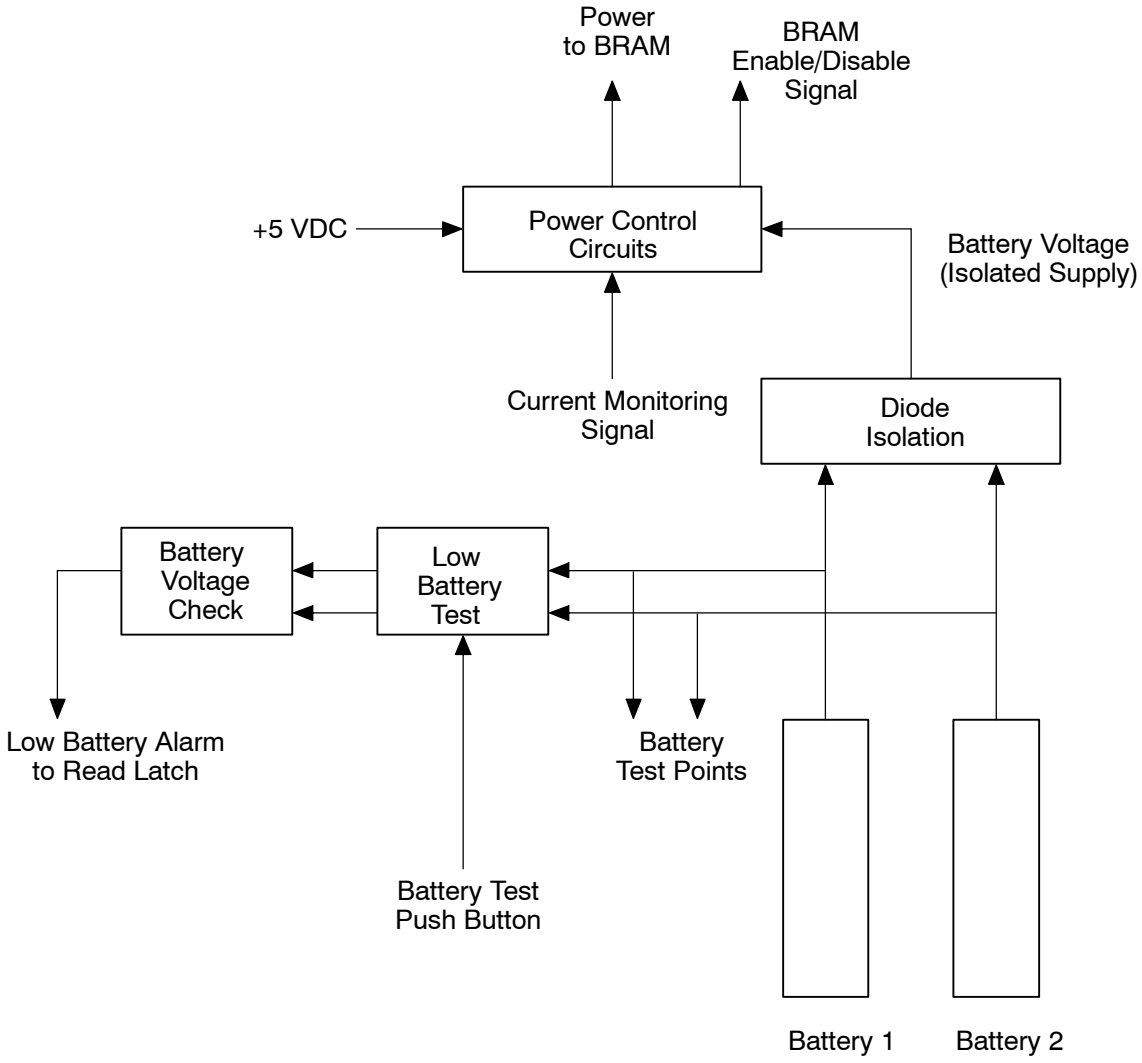


Figure 3.7.43. RAM NV Memory Battery Control Circuit

The battery control circuit monitors the +5 VDC supply and battery voltages. If the +5 VDC supply falls below the threshold value, the battery control circuit acts to preserve the contents of the BRAM:

- Disables the BRAM, to prevent further reads or writes.
- Resets the OI processor.
- Supplies the BRAM with power from the batteries.

When the +5 VDC supply rises to the threshold level, the battery control circuit restores normal BRAM operation.

The battery control circuit continuously monitors the unloaded voltage of each battery. If a battery voltage falls below the limit, a Low Battery Alarm is sent to the Read Latch.

Once every 24 hours the OI Processor initiates a BRAM current draw test. The current used by the BRAM is measured and reported by the battery control circuit. This can be used to detect static electricity damage to BRAM cells or other abnormal BRAM power conditions. Damaged cells typically draw a much larger current than do normal cells. If a battery fails the test, a Low Battery Alarm is sent to the Read Latch.

The OI Processor periodically accesses the Read Latch. If the Low Battery Alarm is active, the OI Processor lights the low battery LEDs.

You can start the battery voltage test by hand with the momentary contact switch at the top of the card. The test points allow direct measurement of battery voltage.

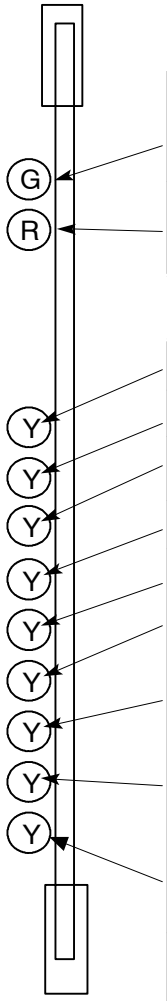
Two 3.6 V AA lithium batteries (chosen for long life and high reliability) are used. New batteries can keep RAM in continuous data retention mode for several years. Disable both batteries if OI NV Memory is not used for data retention and normal +5 VDC is not available. This prevents unnecessary battery discharge.

Since RAM cells that have been damaged by static electricity discharge draw considerably more power than undamaged cells, it is possible that battery drain in the standby condition can be much higher than normal, with the resulting shortened battery life. An OI NV RAM that shows an abnormal BRAM current draw should be returned to the factory for repair.

If one battery requires replacement, replace both batteries. Backup RAM data to disk before changing the batteries. Remove one battery at a time to allow the other battery to power the RAM. Replace the lower reading battery first. See Chapter 9, Maintenance , for the complete battery replacement procedure.

OI NV RAM LEDs and Test Points

Figure 3.7.44 shows the LEDs on the OI NV RAM card.



DS1 (Green)	No faults are detected on the card. DS1 lights when the card has passed power up diagnostics.
DS2 (Red)	A fault has been detected on the card. DS2 lights when the card has failed power up diagnostics.

DS4 (Yellow)	Battery 1 is low. Replace both batteries (battery 1 first).
DS5 (Yellow)	Battery 2 is low. Replace both batteries (battery 2 first).
DS6 (Yellow)	TXD for RS-422 channel.
DS7 (Yellow)	RXD for RS-422 channel.
DS8 (Yellow)	CTS for RS-422 channel.
DS9 (Yellow)	RXD for RS-232 channel.
DS10 (Yellow)	CTS for RS-232 channel.
DS11 (Yellow)	TXD for RS-232 channel.
DS12 (Yellow)	Status LED 1: Operation: Program Access Power-up Test: Low order bit of test number.
DS13 (Yellow)	Status LED 2: Operation: Writing to the Bubble. Power-up Test: Middle bit of test number.
DS14 (Yellow)	Status LED 3: Operation: Reading from the Bubble. Power-up Test: High order bit of test number.

Figure 3.7.44. OI NV RAM LEDs

Figure 3.7.45 shows test points and the Battery Load test switch on the OI NV RAM card. You can start the battery load test by hand by closing this switch momentarily. An alarm is issued if the battery fails the test.

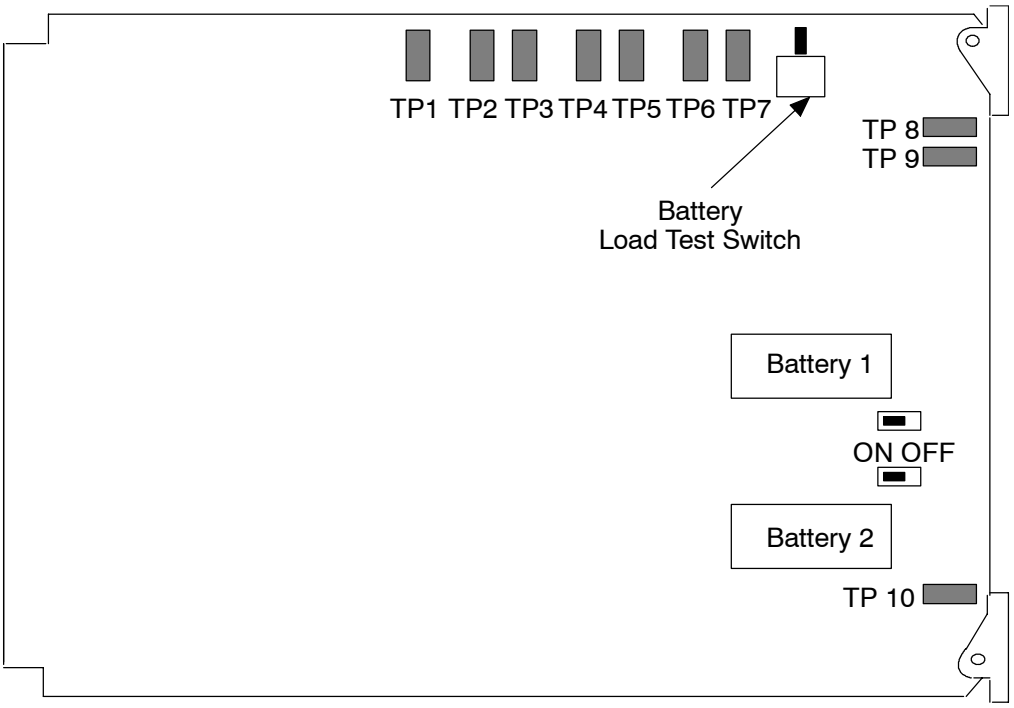


Figure 3.7.45. OI NV RAM Memory Test Points

Table 3.7.27 lists the name, color, and purpose of the test points.

Table 3.7.27. OI NV RAM Memory Test Points

Test Point	Color	Purpose
TP1 +5V1	Yellow	RS-422 isolated +5 V supply
TP2 IG1	Gray	RS-422 isolated ground
TP3 +5V2	Yellow	RS-232 isolated +5 V supply
TP4 IG2	Gray	RS-232 isolated ground
TP5 +9V	Purple	Comparator supply
TP6 B1C	White	Battery 1 current
TP7 B2C	Green	Battery 2 current
TP8 B1V	White	Battery 1 voltage
TP9 B2V	Green	Battery 2 voltage
TP10 GND	Brown	Logic ground

OI NV RAM LED Sequences

In normal operation, the green LED is ON. DS6 through DS8 flash for RS-422 communications. DS9 through DS11 flash for RS-232 communications. DS12 through DS14 flash as reads and writes are made to the RAM.

The boot sequence has the red LED (DS2) ON with the three yellow status LEDs (DS12, DS13, DS14) flashing. If a power-up test succeeds, the green LED lights. If the power-up test fails, the red LED will stay ON and the number of the failed test will be displayed in the status LEDs, as indicated in Table 3.7.28.

Table 3.7.28. OI NV RAM LED Sequences

Status LEDs (DS12, 13, 14)	Failed Test
OFF **ON** **ON**	Failure in read/write tests of RAM.
ON **ON** **ON**	Bad program length, failed SCI image checksum, or both 30 VDC power supplies bad.

OI NV RAM Jumpers

Figure 3.7.46 shows the location of the jumpers on the OI NV RAM card. Table 3.7.29 lists jumper values.

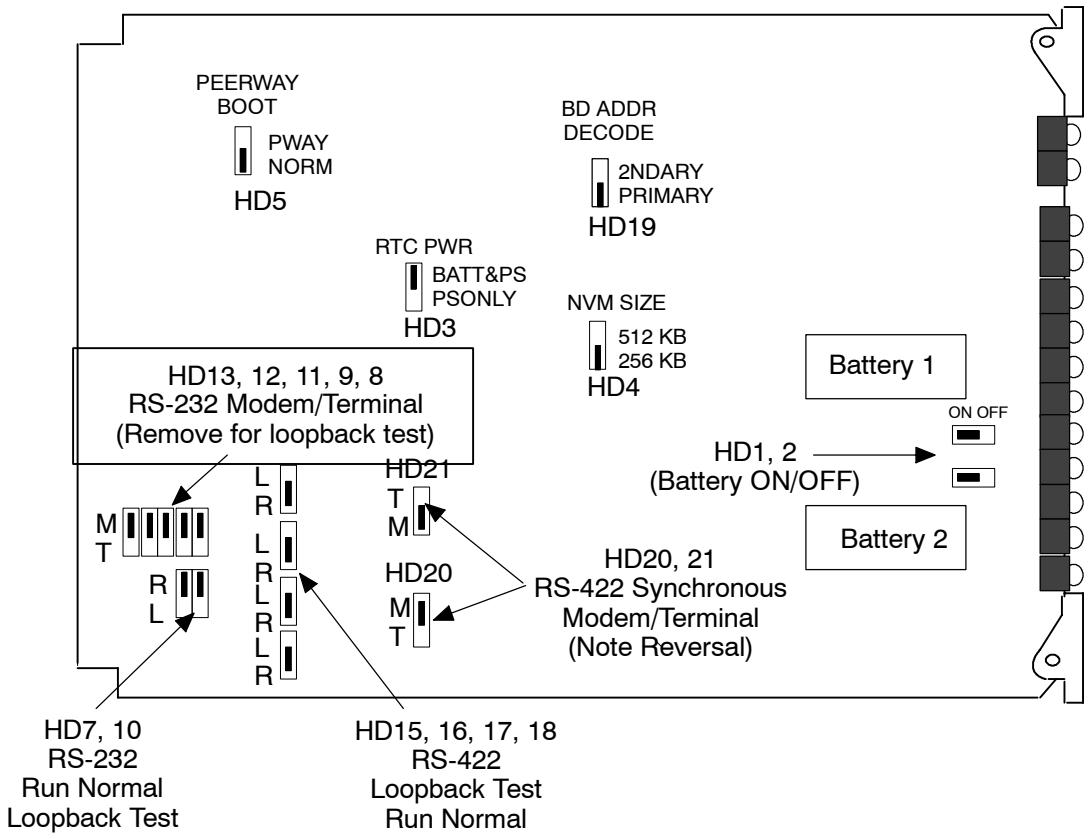


Figure 3.7.46. OI NV RAM Memory Jumpers

Battery Jumpers: Set battery jumpers (HD1 and HD2) to OFF when RAM battery is not needed.

Jumper HD3 (RTCPWR) selects battery backup for the Real Time Clock. This jumper is hardwired.

Modem or Terminal Jumpers: Jumpers HD8, 9, 11, 12, and 13 select RS-232 operation as either a Modem (M) or a Terminal (T). Set them all to the same value.

NOTE: Remove jumpers HD8, 9, 11, 12, and 13 for the RS-232 local loopback test. Be sure to replace them correctly when the test is completed.

Jumpers HD20 and HD21 select RS-422 operation as either a Modem (M) or a Terminal (T). For X.25 (synchronous) operation both must be set to the same value. These jumpers are hardwired in cards ordered for non-X.25 (asynchronous) operation.

NOTE: The “M” and “T” positions of HD20 and HD21 are reversed.

Loopback Test Jumpers: Use jumpers marked “L” and “R” only for local loopback tests. Set them on Run Normal (“R”) for operating the card. HD7 and HD10 are used for RS-232. HD15, 16, 17, and 18 are used for RS-422 operation.

NOTE: The Modem or Terminal jumpers must be removed for the RS-232 local loopback test. Be sure to replace them correctly when the test is completed.

Board Address Decode Jumpers: The Board Address Decode jumper (HD19) distinguishes between two OI NV RAM cards inserted in the card cage at the same time. One must be jumpered as “PRIMARY”, the other as “2NDARY” (secondary). This is needed to restore bad data in the BRAM.

The bad card is jumpered “PRIMARY”, and the known good card is jumpered “2NDARY”. When the card cage is powered up, the OI Processor boots from the secondary (good) card and begins operation. The operator can copy data to the primary (bad) card.

PeerWay Boot Jumper: The PeerWay Boot jumper (HD5) is used to force a PeerWay boot. Set it to NORM for normal operation.

To force a PeerWay boot, power down the card cage. Set the jumper to PWAY and restore cage power. The OI Processor will boot from the PeerWay. Power down again and return the jumper to NORM. Power up for normal operation.

Table 3.7.29. OI NV RAM Jumper Values

Jumper	Value	Purpose
HD1 (BATT 1)	**ON**	Battery 1 Connected
	OFF	Battery 1 Disconnected
HD2 (BATT 2)	**ON**	Battery 2 Connected
	OFF	Battery 2 Disconnected

(continued on next page)

Table 3.7.29. OI NV RAM Jumper Values (continued)

Jumper	Value	Purpose
HD3 (RTCPWR)	BAT&PS	Hardwired
	PS ONLY	--
HD4 (NVM SIZE)	512 KB	Hardwired for number of RAM chips used
	256 KB	Hardwired for number of RAM chips used
HD5 (PEERWAY BOOT)	PWAY	Force PeerWay boot
	NORM	Normal operation
HD7, HD10	R	Run Normal Communications (RS-232)
	L	Communications Loopback Test (RS-232)
HD8, 9, 11, 12, 13	M	Function as a Modem (RS-232) (Remove for Loopback Test)
	T	Function as a Terminal (RS-232) (Remove for Loopback Test)
HD15, 16, 17, 18	L	Communications Loopback Test (RS-422)
	R	Run Normal Communications (RS-422)
HD19 (BD ADRR DECODE)	2NDARY	Address this board as Secondary (See text)
	PRIMARY	Address this board as Primary (See text)
HD20	M	Function as a Modem (RS-422)
	T	Function as a Terminal (RS-422) (Hardwired for non-X.25 operation)
HD21	M	Function as a Modem (RS-422) (Hardwired for non-X.25 operation)
	T	Function as a Terminal (RS-422)

OI NV RAM Battery Replacement

Replace the batteries at least once a year or if any Low Battery LEDs light. Replace both batteries, but disable them one at a time to allow the other to retain the RAM contents. Use only 3.6 volt lithium batteries (C52932-0002).

NOTE: A disk backup should be made before the OI NV RAM card is removed for battery replacement. Follow recommended procedures in powering down the Operator Interface Card Cage. Use static protection whenever handling the OI RAM NV card.

CAUTION

If one battery is low, replace the low battery first to ensure data retention.

❑ **To replace the batteries:**

1. Disable battery one by moving jumper HD1 to OFF.
2. Remove and replace battery one.
3. Enable battery one by moving jumper HD1 to ON.
4. Repeat for battery two, using jumper HD2.

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ControlFiles

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Section 1:
ControlFile Card Cage

These versions of the ControlFile Card Cage are in service:

- ControlFile Card Cage (EMC compliant) 10P52960001
- ControlFile Card Cage (with blower) 1984-3048-000x
- ControlFile Card Cage 1984-0023-000x

NOTE: To retain EMC compliance in a 10P52960001 ControlFile, you must use the MPCII (10P50400006) or MPC5 (10P57520007) Controller Processor.

The ControlFile Card Cage houses the PeerWay Buffer, Power Regulator, Coordinator Processor, Nonvolatile Memory, and Controller Processor cards. A redundant pair of PeerWay Buffer cards is standard. One Power Regulator card and one Coordinator Processor card are standard, though each can be made redundant with the addition of another card. One Nonvolatile Memory card is standard. There is a slot for a second memory card but only one card can be enabled at a time. Up to eight Controller Processor cards can be configured, in any combination, including standalone units or as redundant pairs. Figure 4.1.1 shows the front of a ControlFile Card Cage.

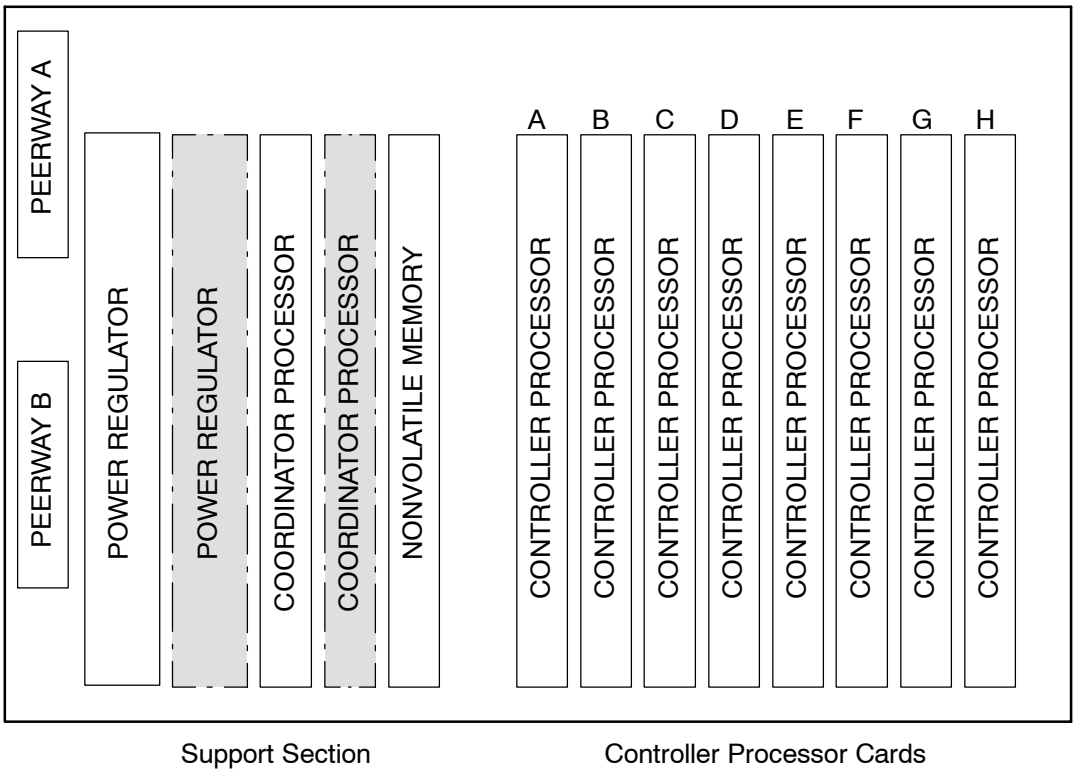


Figure 4.1.1. ControlFile Card Cage (Front)

The ControlFile motherboard interconnects the power and signals of all cards in the ControlFile Card Cage. Power and signal connections include:

- DC power A and B
- PeerWay Tap Boxes A and B
- Cage alarm contacts
- I/O Card Cage connectors
- Plenum Fan Power (except –0023)

The motherboard is a multilayer card. The inner layers carry power and ground and the outer layers carry the data, address, and control signals across the motherboard. The data, address, and control lines are fully redundant. Each line extends from one Coordinator Processor (CP) card to the Controllers.

Coordinator Processor, Controller Processor, and Nonvolatile Memory cards have redundant buffering to isolate failures and prevent the failures from affecting the other cards. Redundant PeerWay Buffer cards each have their own bus. The dedicated Coordinator Processor bus is a 32-bit parallel bus that allows data transfer between redundant Coordinator Processor cards.

There are two rows of connectors across the backplane of the motherboard: an upper and a lower. The upper row is used by the MultiPurpose Controller. Each Controller slot has a corresponding connector that allows connection to the Analog Card Cages and/or FlexTerms. The lower row is used by MultiLoop and Single-Strategy Controllers for the 1 to 5 V input signals, and the .5 to 2.5 V feedback signals from MultiLoop FlexTerms.

Table 4.1.1 shows the parts replacement matrix.

Table 4.1.1. Parts Replacement for the ControlFile Card Cage

Part No.	Replaces	Characteristics
10P5296000x	1984–3048–000x 1984–0023–000x	Provides EMC compliance (when used with MPC II [10P50400006] or MPC5 [10P57520007])
1984–3048–000x	1984–0023–000x	Has integral blower assembly

ControlFile Jumpers

Two groups of jumpers on the ControlFile indicate its node number address. The jumpers must be set to the same address. If they differ, the lowest node address will be used and a “PeerWay Jumpers Bad” alarm message will be issued. Figure 4.1.2 shows the jumper locations. The jumpers are on the back (solder side) of some motherboards and on the front (connector side) of others. Jumpers on the back are unmarked. Those on the front are marked HAA and HAB and are numbered as shown in Figure 4.1.3 and Figure 4.1.4.

Table 4.1.2 gives jumper values. Figure 4.1.3 shows the Jumper setting to give a node address of 29.

NOTE: The “H” and “L” positions are reversed when the jumpers are on the back of the motherboard.

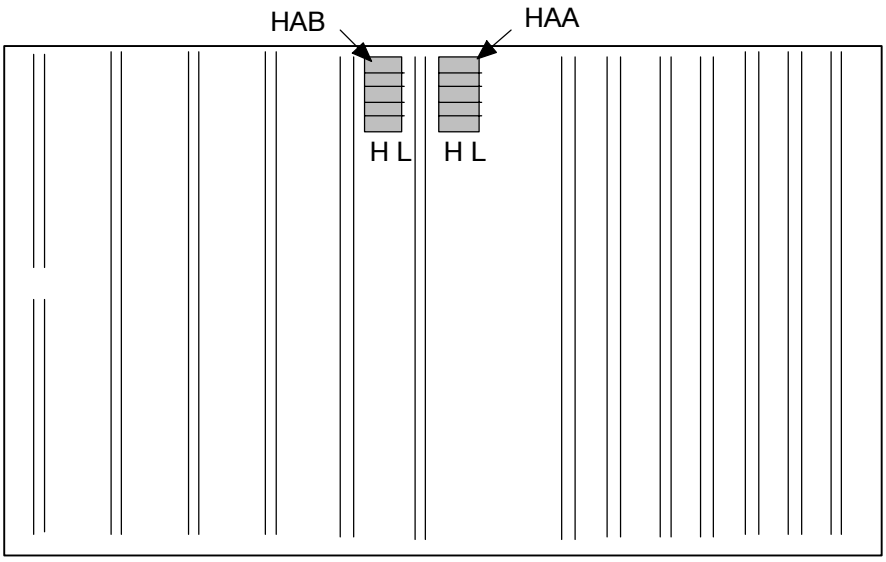
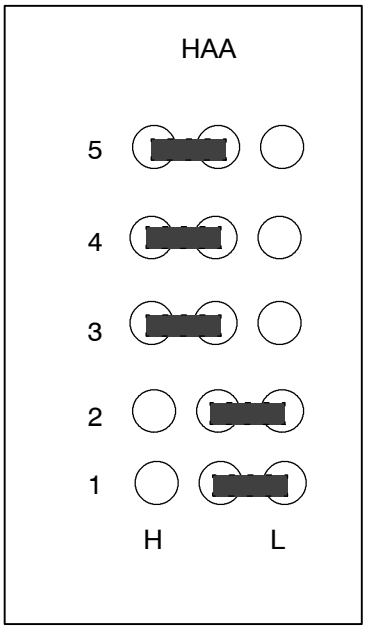


Figure 4.1.2. ControlFile Motherboard Jumper Locations

Table 4.1.2. ControlFile Motherboard Jumper Values

Jumper	Value at H	Value at L
5	16	0
4	8	0
3	4	0
2	2	0
1	1	0



HD5 at H = 16

HD2 at H = 8

HD3 at H = 4

HD4 at L = 0

HD4 at L = 0

Sum of Jumpers = 28
+ 1
Node Address = 29

Figure 4.1.3. Setting the ControlFile Node Address Jumpers

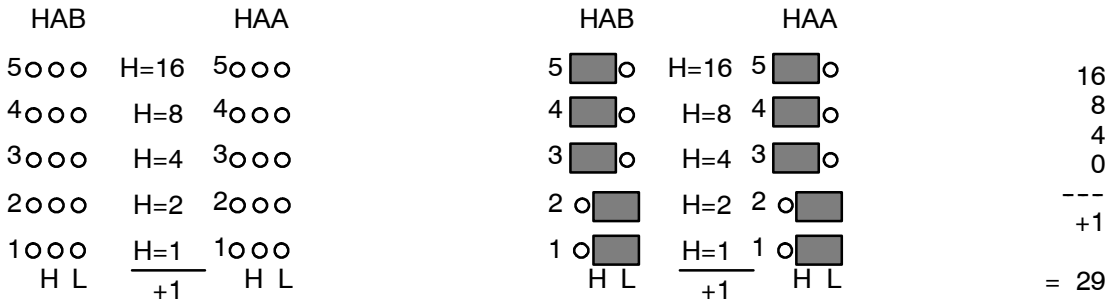


Figure 4.1.4. Setting the CE ControlFile (10P52960001) Node Address Jumpers

ControlFile Data Bus Terminators

The motherboard data bus is terminated with two Data Bus Terminators. Non-EMC ControlFile Card Cages (1984-3048-000x and 1984-0023-000x) use removable terminators. These terminators sometimes are dislodged when working with wiring. Replace them exactly as shown in the appropriate figure.

NOTE: ControlFile 10P52960001 has the terminators built into the motherboard.

The following versions are in use:

- ControlFile Terminator II (1984-3270-0001)
- ControlFile Terminator Board (Top) (1984-1231-0001)
- ControlFile Terminator Board (Bottom) (1984-1243-0001)

ControlFile Terminator II

The ControlFile Terminator II (1984-3270-0001) is marked "CF TERMINATOR II" on the PWA. This board is used in both top and bottom positions. It must be installed as shown in Figure 4.1.5.

NOTE: The board is installed with the component side inward. The holes in the board must be on the right side for both the top and the bottom board. The solder side is marked "UP" and "DOWN" to assist in orienting the board.

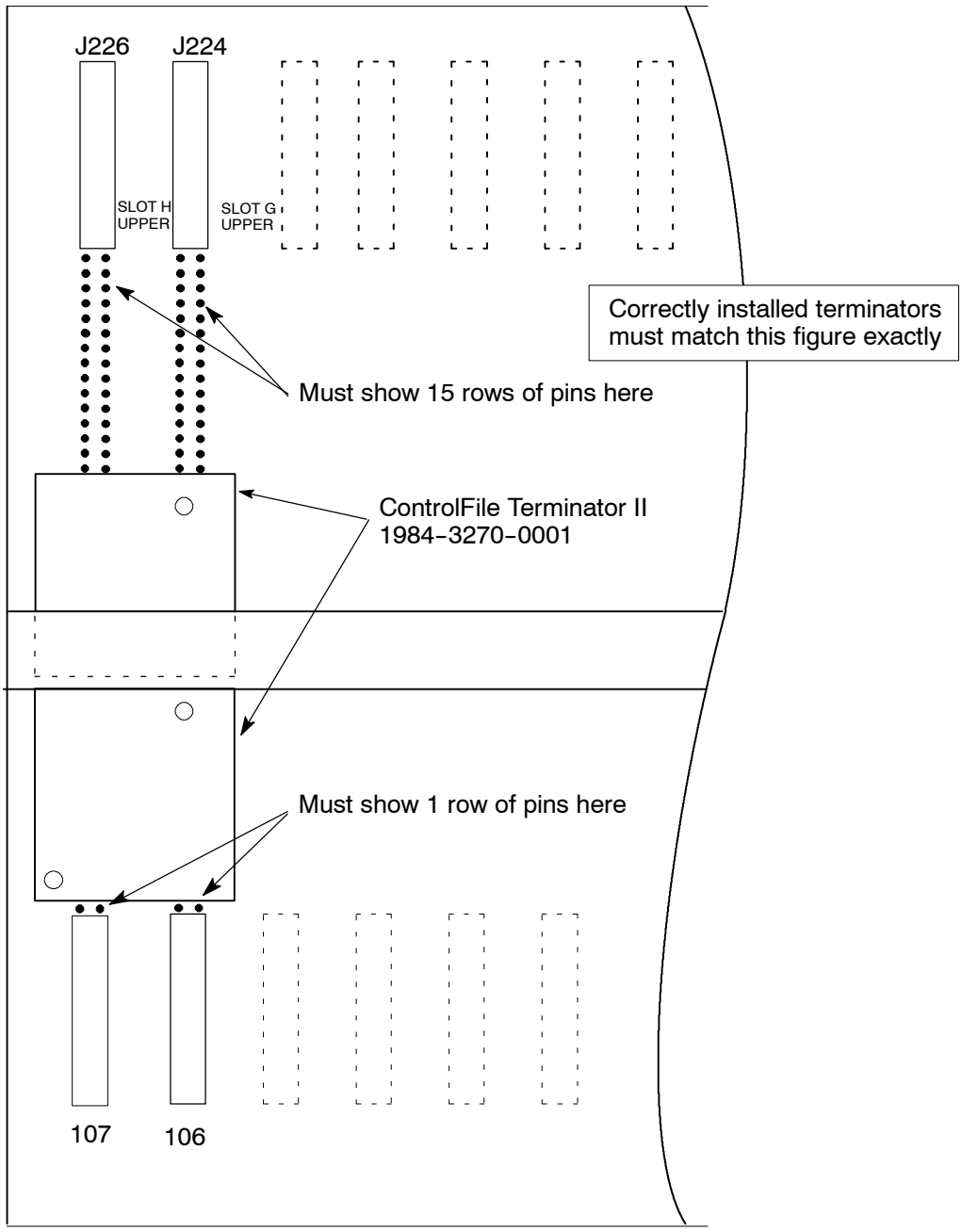


Figure 4.1.5. ControlFile Motherboard Terminator II Installation

ControlFile Terminator Boards

ControlFile Terminator Board (Top) (1984–1231–0001) is used in the top position.

ControlFile Terminator Board (Bottom) (1984–1243–0001) goes in the lower position. It is marked “TERMINATOR CONTROLFILE BOTTOM” on the PWA.

NOTE: Install the board with the component side inward.

The pair of terminators must be installed as shown in Figure 4.1.6.

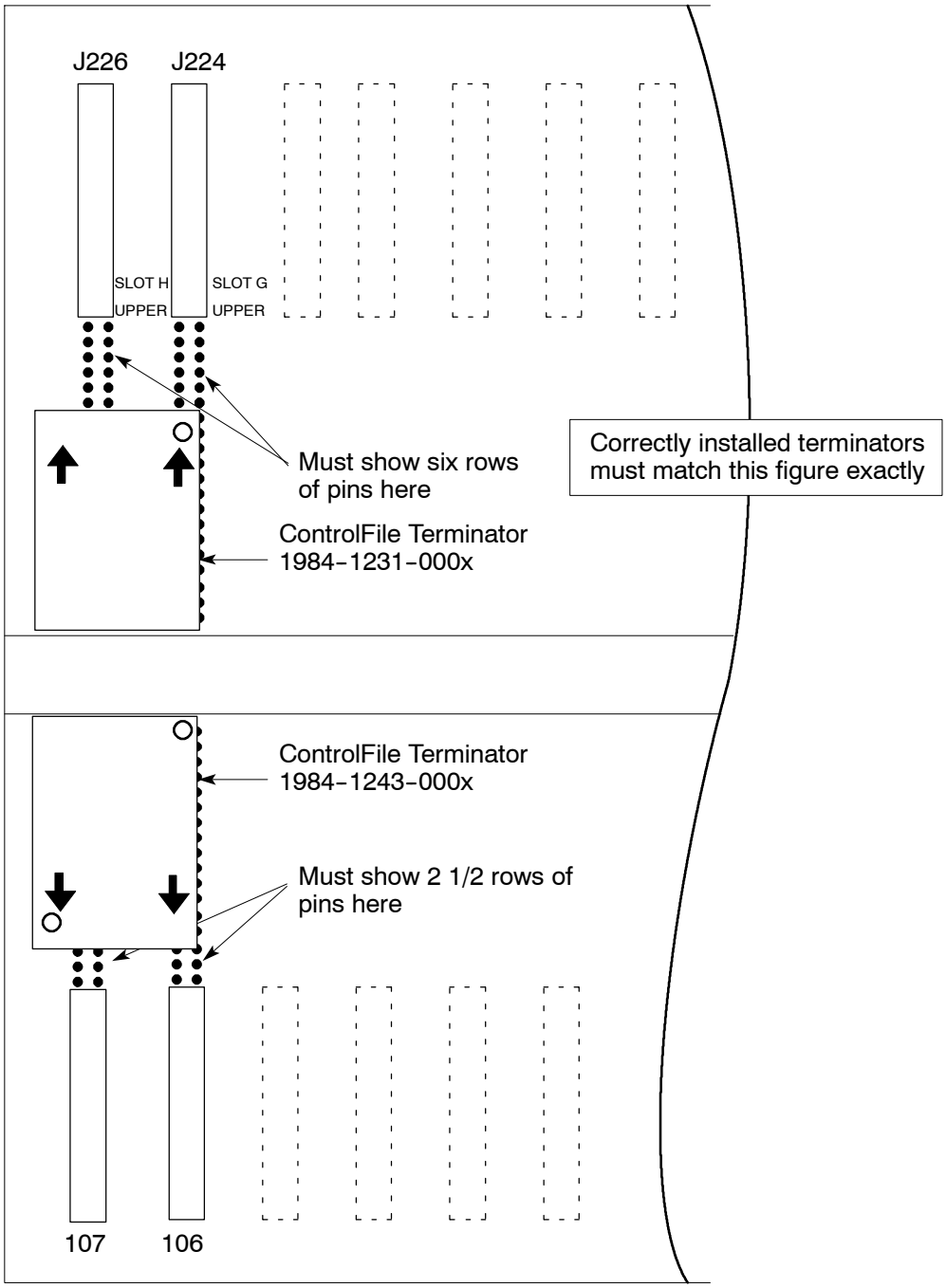


Figure 4.1.6. ControlFile Motherboard Terminator Board Installation

Section 2:
ControlFile Support Section

The ControlFile support section consists of:

- PeerWay Buffer
- 5 VDC Only Power Regulator
- 5 VDC and 12 VDC Power Regulator
- Coordinator Processor (CP)
- Nonvolatile (NV) Memory
- RAM Nonvolatile Memory
- Bubble Nonvolatile Memory

The ControlFile Card Cage is covered in section 1 of this chapter. The Controller Processor cards are covered in section 3 of this chapter. Maintenance and troubleshooting are covered in chapters 9 and 10.

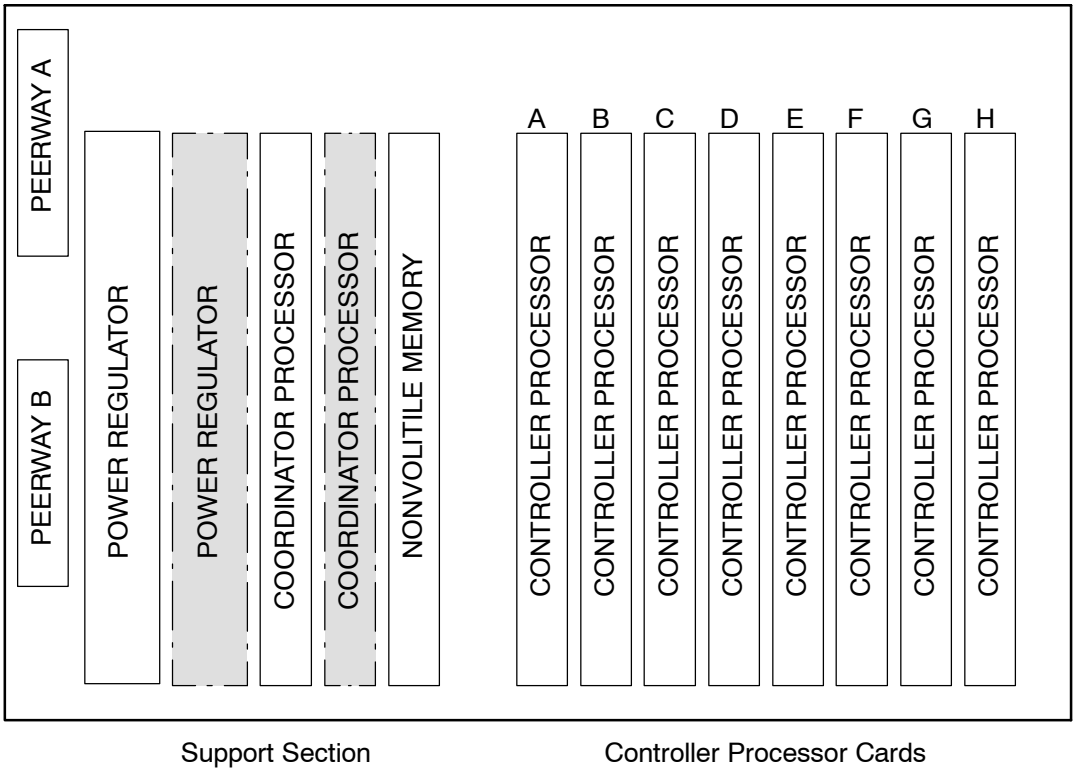


Figure 4.2.1. ControlFile Card Cage (Front)

PeerWay Buffer

PeerWay Buffer cards (1984-1502-000x and 1984-1402-000x) communicate serial data and control signals between the Coordinator Processor and the PeerWay tap for transmission on the PeerWay. Two PeerWay Buffer cards are required for interface to the A and B PeerWays and each can communicate its data with either of the two Coordinator Processor cards. Figure 4.2.2 shows a functional diagram for a PeerWay Buffer card.

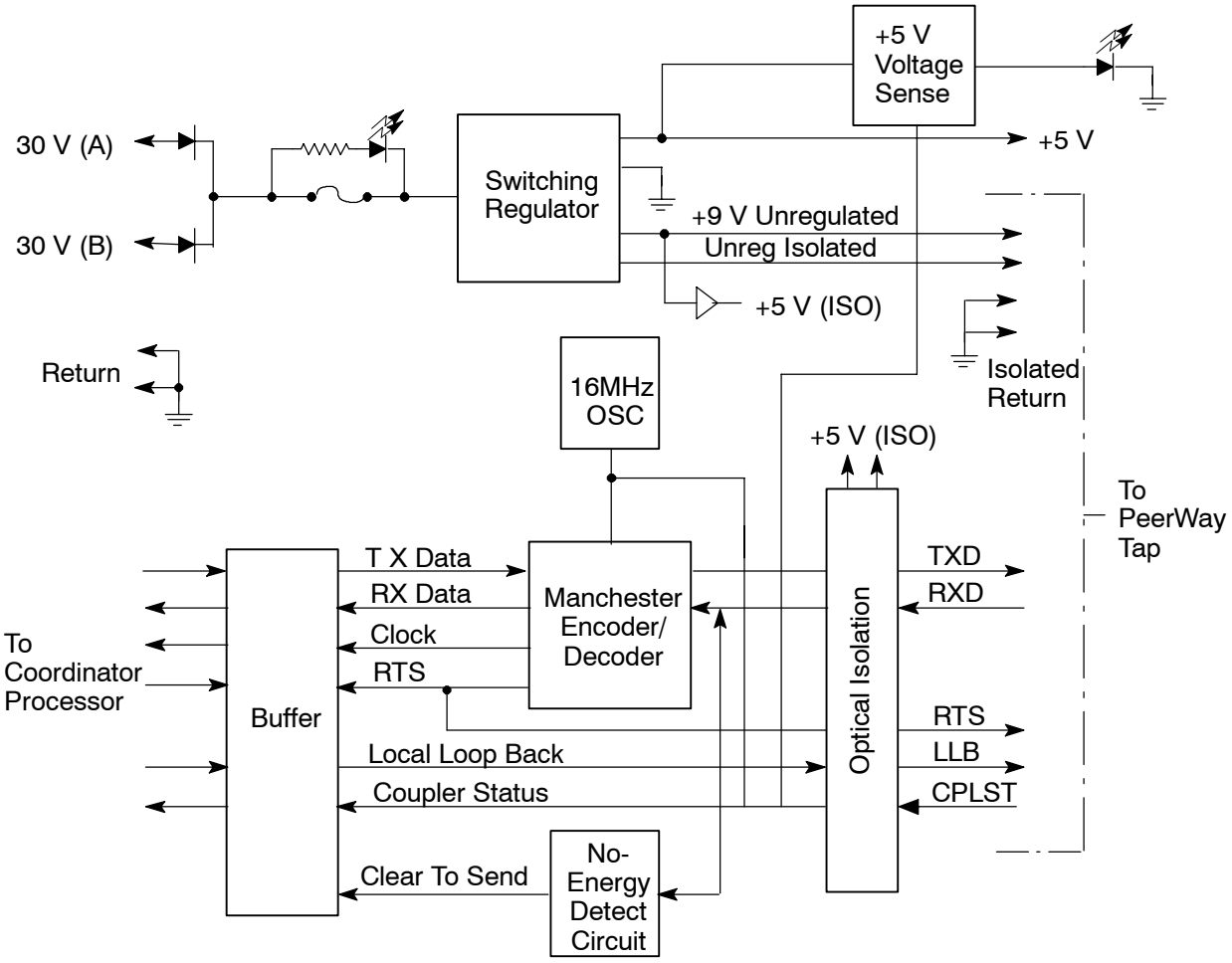


Figure 4.2.2. PeerWay Buffer Functional Diagram

Data is buffered through a single buffer chip for isolation. An onboard 16 MHz clock and clock divider generate the necessary timing signals for data communication. A switching regulator provides +5 V with overvoltage protection for the card and is checked by comparators for voltage tolerance. The same transformer also generates isolated +9 V for isolation circuitry necessary for the PeerWay interface devices and tap card. A three-terminal +5 volt regulator supplies the proper isolated voltage to the optical isolators and the RS-422 transmitters and receivers.

Transmit (TX) data goes from the buffer chip to the Manchester encoder/decoder. There, data is encoded with a 1 MHz clock signal, optically isolated, and then transferred to the tap by an RS-422 transmitter. The local loop back (LLB) signal used to drive the tap relay is transferred from the buffer to the tap through the optical isolators and the RS-422 transmitter. The Ready To Send (RTS) signal is first disabled by a power up reset flip-flop to ensure all circuitry is stable before the card is enabled to transmit on the PeerWay.

Receive data is fed through an optical isolator to the Manchester encoder/decoder where data is separated from the clock signal. An internal phase locked loop synchronizes the cards' internal clock with the receive signal clock. Both the clock signal and the data are buffered and sent to the Coordinator Processor card advanced data link controller (ADLC). The Clear-To-Send (CTS) signal is asserted by a counter to detect when data is present on the receive line. The CP line status (CPLST) is received, isolated, and fed directly to the Coordinator Processor card. CPLST provides several functions:

- TAP
  - Watchdog time-out (RTS active for too long)
  - Cable disconnected
- BUFFER
  - +5 VDC out of tolerance
  - Oscillator failed

Table 4.2.1 shows parts replacement data for the card.

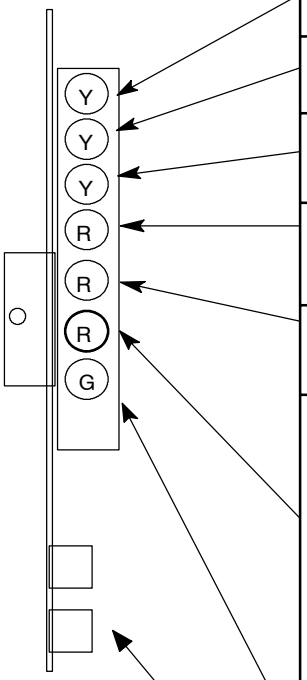
Table 4.2.1. Parts Replacement for PeerWay Buffer

Part No.	Replaces	Characteristics
1984-1502-000x	1984-1402-000x	Marked "PEERWAY BUFFER" on the PWA
1984-1402-000x		No name marked on the PWA

PeerWay Buffer LEDs and Test Points

The PeerWay Buffer has LEDs to indicate card status. Figure 4.2.3 shows the LED indicators for the PeerWay Buffer.

The two test points are shown in Figure 4.2.3.



LEDS

RTS (DS7)	Request-To-Send signal active; Enables transmission on the PeerWay.
TXD (DS6)	Transmitting to the PeerWay.
BUS ACTIVE (DS5)	Card active: Data is being transmitted or received through the Coordinator Processor.
+5 V FAULT (DS4)	PeerWay buffer voltage comparators have sensed that the main regulator is out of operating tolerance (voltage is high or low).
FUSE BLOWN (DS3)	Replace Fuse F1 (Supplies power to the PeerWay Buffer Power Regulator).
STATUS FAULT (DS2)	The status timer has timed out, indicating the RTS Signal has been enabled too long and the jabber-halt relay has opened. The RTS signal is forced OFF to keep the node from interfering with the PeerWay. The fault could be the status timer in the PeerWay Tap, the RTS signal on the Coordinator Processor, the Tap Board connection, or loss of the onboard clock, which is a PeerWay Buffer or Coordinator Processor problem.
STATUS GOOD (DS1)	The timer on the PeerWay Tap is in its normal operating mode.

Test Points for +5 VDC

+5V (Yellow)	5 VDC test point.
Return (Brown)	5 VDC return.

Figure 4.2.3. PeerWay Buffer LEDs

PeerWay Buffer Jumpers

Figure 4.2.4 shows the jumper locations for PeerWay Buffer card 1984-1502-000x. Card 1984-1402-000x has no jumpers. Jumpers should be moved only for a loop-back test. Table 4.2.2 shows the jumper positions.

NOTE: The PeerWay node address of the ControlFile is set by jumpers on the ControlFile motherboard.

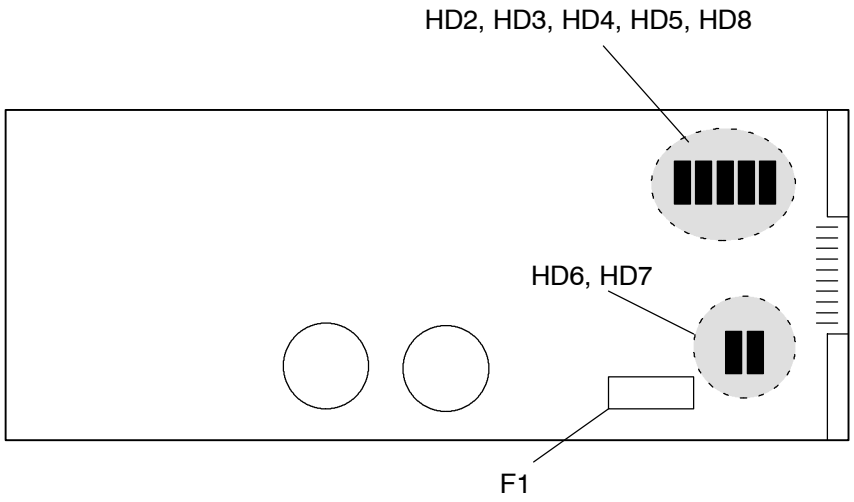


Figure 4.2.4. PeerWay Buffer 1984-1502-000x Fuse and Jumper Locations

Table 4.2.2. PeerWay Buffer 1984-1502-000x Jumper Positions

Jumper	Signal	Normal	Loop Back Test
HD1	Not used	Not used	Not used
HD2	Receive Clock	2-3	1-2
HD3	Transmit Clock	2-3	1-2
HD4	Receive Data	2-3	1-2
HD5	Transmit Data	2-3	1-2
HD6	Ready to Send	2-3	1-2
HD7	BSL (Coupler Status)	2-3	1-2
HD8	Clear to Send	2-3	1-2

PeerWay Buffer Fuse

Figure 4.2.4 shows the PeerWay Buffer fuse location. Table 4.2.3 gives fuse data.

Table 4.2.3. PeerWay Buffer Fuse

Fuse	FRSI Part No.	Bussman Part No.	Littelfuse Part No.	Characteristics
F1	G09149-0022	AGC 1	312001	1 A 250 V Quick Acting

ControlFile 5 VDC Only Power Regulator

The ControlFile 5 VDC Only Power Regulator (1984-3505-000x) provides power to all cards in the ControlFile except the two PeerWay Buffers. The card is marked “CONTROLFILE POWER REGULATOR 5V ONLY” on the Printed Wiring Assembly (PWA).

The ControlFile 5 VDC Only Power Regulator is used only in ControlFiles with RAM NV Memory (1984-2347-00xx). It does not supply +12 VDC and -12 VDC required to support Bubble NV Memory (1984-1598-000x, 1984-1483-000x, or 1984-1224-000x).

CAUTION

Disable the NV Memory and then the Coordinator Processor cards before removing any card (other than a PeerWay Buffer card) from the ControlFile. Failing to do so may cause a corrupted data transfer.

A redundant Power Regulator is optional. If two Power Regulators are used, the one in the left slot becomes the master and controls the output of the one in the right slot (the slave). A ControlFile 5 VDC Only Power Regulator may be paired with a 5 VDC and 12 VDC Power Regulator in ControlFiles that use RAM NV Memory.

Table 4.2.4 shows parts replacement data.

Table 4.2.4. ControlFile 5 VDC Only Power Regulator Parts Replacement

Part No.	Replaces	Characteristics
1984-3505-000x	1984-1505-000x 1984-1432-000x	Replaces these cards ONLY in ControlFiles that use NVRAM and MPC Processors.

CAUTION

When inserting a Power Regulator card, push it partially in and pause to allow the capacitors to charge. The LED will blink once. Then seat the card firmly. Failure to allow the capacitors to charge can result in burned edge connector contacts.

The ControlFile 5 VDC Only Power Regulator has one output:

- +5 volts with over voltage and current protection.

Figure 4.2.5 is a functional diagram for the ControlFile 5 VDC Only Power Regulator.

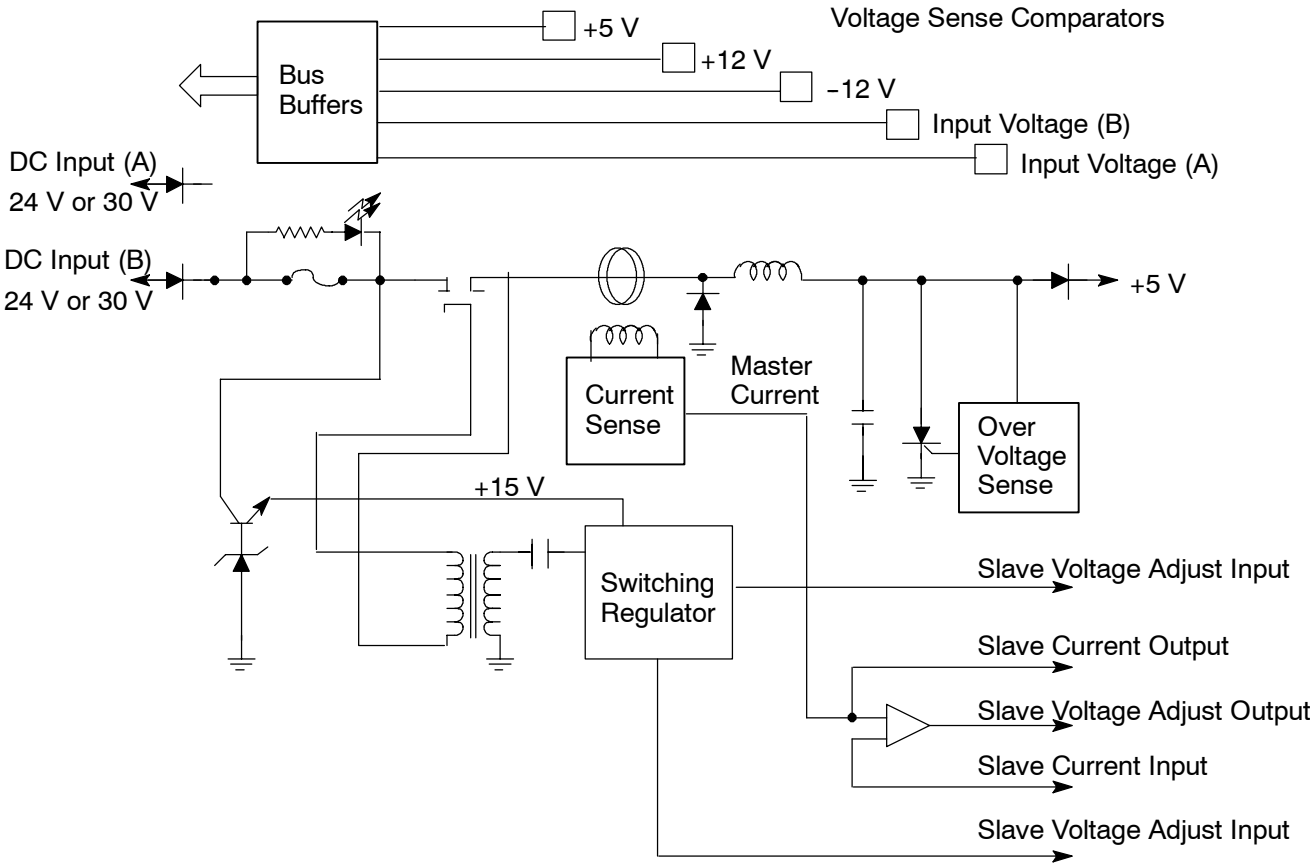


Figure 4.2.5. ControlFile 5 VDC Only Power Regulator Functional Diagram

The 5 V output is used for all logic circuitry. The +5 volt power regulator is a buck type regulator. The input voltage is turned on and off at a 25 KHz rate with a pulse width that varies with the input voltage. Four parallel power field effect transistors (FET) are turned on by the switching regulator as the output sense determines the need for added current. To turn on the FETs, the gate voltage must be 10 volts above the input voltage rail. A transformer and DC restoring circuit is used to provide the required voltage. Power to the regulator is preregulated by a zener transistor combination.

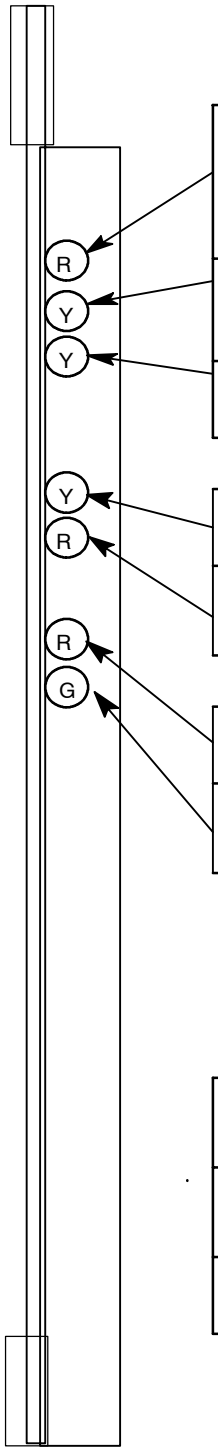
Load sharing is accomplished by the current sense from the regulator being fed into an error amplifier. The output of the amplifier is then used to raise or lower the output voltage of the slave card.

The +12 V and -12 V status lines are tied to ground in order to indicate proper 12 VDC status to the Coordinator Processor.

The 5 VDC voltage output and both buses are monitored through a comparator for voltage tolerance. Each has a yellow LED to indicate that the power is good. If the +5 volt regulator fails, a red LED lights. In case of failure, all output lines are statused and buffered to the Coordinator Processor through the motherboard bus to generate alarms.

ControlFile 5 VDC Only Power Regulator LEDs and Test Points

The ControlFile 5 VDC Only Power Regulator has LEDs to indicate card status. Figure 4.2.6 shows the LEDs and test points for the Power Regulator. Test points are accessible from the top of the ControlFile.



LEDs

+5 V POWER CHARGE (DS10)	Input capacitors are charging during card insertion with card cage power on. The proper procedure is to slowly insert the card into the ControlFile Motherboard connector (the LED will blink on briefly).
INPUT B STATUS (DS9)	Bus B (24 VDC or 30 VDC) from the DC distribution system is within operating tolerance. Normally OFF if only one DC bus is used.
INPUT A STATUS (DS8)	Bus A (24 VDC or 30 VDC) from the DC distribution system is within operating tolerance.
+5 V STATUS (DS5)	The +5 VDC regulator is within operating tolerance.
CARD FAULT (DS4)	The +5 VDC regulator section is out of operating tolerance. Replace the card.
5 V FUSE BLOWN (DS2)	Replace Fuse F2 (Power to the +5 VDC Power Regulator).
CARD GOOD (DS1)	+5 VDC Supply is within operating tolerance. Does not include status of the DC buses.

Test Points

BROWN	Ground return
YELLOW	+5 VDC Regulator
WHITE	+5 V Relative current indication

Figure 4.2.6. ControlFile 5 VDC Only Power Regulator LEDs and Test Points

ControlFile 5 VDC Only Power Regulator Jumpers

The ControlFile 5 VDC Only Power Regulator may be jumpered for 30 VDC or 24 VDC input. It should be jumpered for 30 volt DC input unless it is necessary to use 24 VDC input to allow a +24 volt uninterruptible power supply source to tie in with a ControlFile.

Figure 4.2.7 shows the jumper locations for the ControlFile 5 VDC Only Power Regulator. Table 4.2.5 shows the jumper positions.

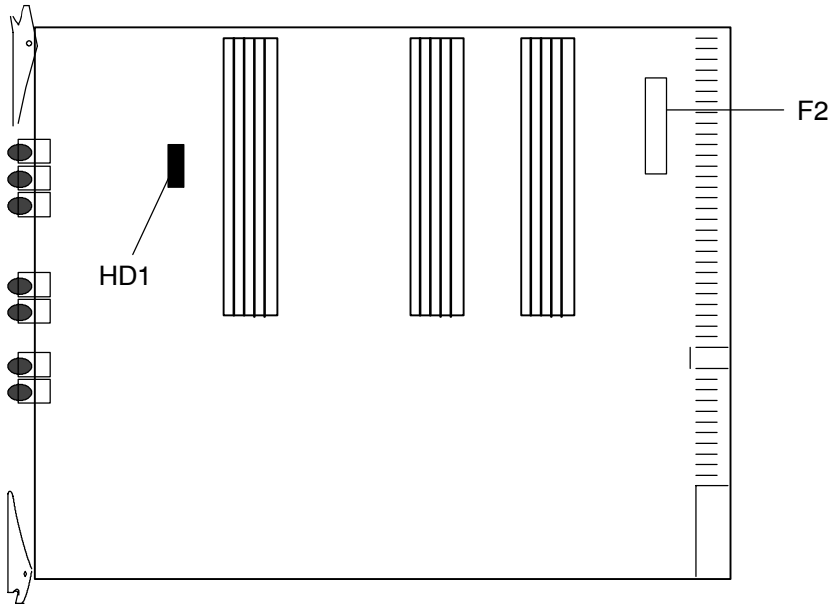


Figure 4.2.7. ControlFile 5 VDC Only Power Regulator Jumper and Fuse Locations

Table 4.2.5. ControlFile 5 VDC Only Power Regulator Jumper Positions

Jumper HD1	Position 1-2	Position 2-3
30 V Input		**ON**
24 V Input	**ON**	

ControlFile 5 VDC Only Power Regulator Fuse

Figure 4.2.7 shows location of the ControlFile 5 VDC Only Power Regulator fuse. Table 4.2.6 gives the fuse value and part number.

Table 4.2.6. ControlFile 5 VDC Only Power Regulator Fuse

Fuse	FRSI Part No.	Bussman Part No.	Littelfuse Part No.	Characteristics
F2	G09140-0061	ABC 20	314020	20 A 250 V Regular

ControlFile Power Regulator 5 VDC and 12 VDC

The ControlFile Power Regulator 5 VDC and 12 VDC (1984-1505-000x and 1984-1432-000x) provides power to all cards in the ControlFile except the two PeerWay Buffer cards. The cards are marked “CONTROLFILE POWER REGULATOR” on the PWA.

A redundant Power Regulator is optional. If two Power Regulators are used, the one in the left slot becomes the master and controls the output of the one in the right slot (the slave).

The ControlFile Power Regulator 5 VDC and 12 VDC may be used in ControlFiles with either RAM NV Memory or Bubble NV Memory. The card may replace a 5 VDC Only Power Regulator in a ControlFile that has only RAM NV Memory. It may be used as a redundant card in either slot of a RAM NV Memory only ControlFile. Table 4.2.7 shows parts replacement data.

Table 4.2.7. ControlFile Power Regulator 5 VDC and 12 VDC Parts Replacement

Part No.	Replaces	Characteristics
1984-1505-000x	1984-1432-000x	30 VDC or 24 VDC input selectable by jumper. 3 or 6 amp 12 VDC output selectable by jumper.
	1984-3505-000x	ONLY in a ControlFile with NVRAM.

CAUTION

Disable the NV Memory and then the Coordinator Processor cards before removing any card (other than a PeerWay Buffer card) from the ControlFile. Failure to do so may result in a corrupted data transfer.

The ControlFile Power Regulator 5 VDC and 12 VDC has three outputs:

- +5 volts at 42 amps with over voltage and current protection.
- +12 volts at 3 or 6 amps with over voltage and current protection.
- -12 volts at 3 or 6 amps. Voltage regulation follows the +12 volt supply.

CAUTION

When inserting a Power Regulator card, push it in part way and pause to allow the capacitors to charge. The LED will blink once. Then seat the card firmly. Failure to allow the capacitors to charge can result in burned edge connector contacts.

Figure 4.2.8 is the functional diagram for the ControlFile Power Regulator 5 VDC and 12 VDC.

The 5 V output is used for all logic circuitry and the +12 volt and –12 volt outputs are used for the analog circuits on the Single-Strategy and MultiLoop Controller Processor cards. The +12 volt output is also used for the Bubble Nonvolatile Memory.

The +5 volt power regulator is a buck type regulator. The input voltage is turned on and off at a 25 kHz rate with a pulse width that varies with the input voltage. Four parallel power field effect transistors (FETs) are turned on by the switching regulator as the output sense determines the need for added current. To turn on the FETs, the gate voltage must be 10 volts above the input voltage rail. A transformer and DC restoring circuit is used to provide the required voltage. Power to the regulator is preregulated by a zener-transistor combination.

Load sharing is accomplished by feeding the current sense from both regulators into an error amplifier. The output of the amplifier is then used to raise or lower the output voltage of the slave card.

The +12 and –12 volt supplies are derived from the same transformer through a combination push-pull and flyback switching supply. The primary of the transformer has a pair of switching FETs on each leg that are driven 180 degrees out of phase. A voltage regulator produces an alternating current in the primary at 40 kHz. The regulator has power supplied through a pre-regulator circuit. The secondary of the transformer has a grounded center tap and a set of rectifiers to produce the +12 volt and –12 volt outputs. The output of the +12 volt is sensed and the input pulse width to the transformer is varied to control the output voltage. The card may be jumpered to provide either 3 amps or 6 amps at 12 volts.

The current outputs of the +12 volt and –12 volt supplies are combined through an error amplifier and this output is compared to the current output of the supplies on the slave card. The voltage of the slave card is then adjusted to ensure that both Power Regulator cards share the load in the card cage.

All voltage outputs and both buses are monitored through a comparator for voltage tolerance. Each has a yellow LED to indicate that the power is good. If the +5 volt, +12 volt, or –12 volt regulator fails, a red LED lights. In case of failure, all output lines are statused and buffered to the Coordinator Processor card through the motherboard bus to generate alarms.

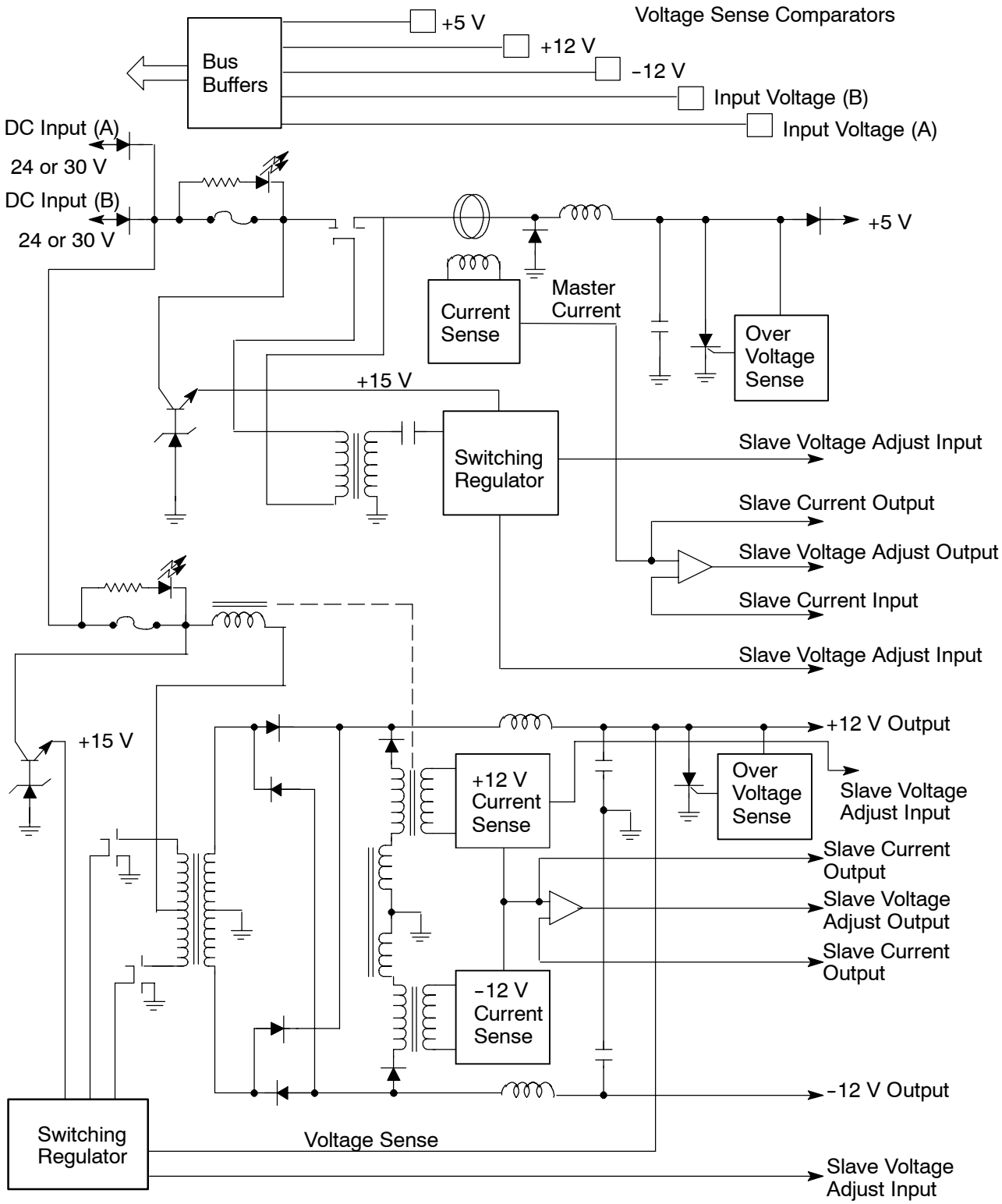
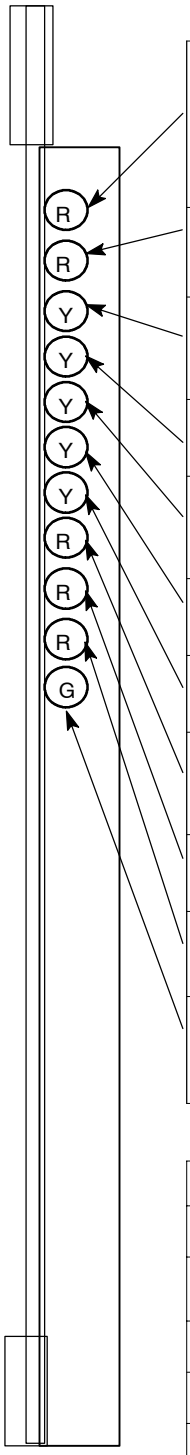


Figure 4.2.8. ControlFile Power Regulator 5 VDC and 12 VDC Functional Diagram

ControlFile Power Regulator 5 VDC and 12 VDC LEDs and Test Points

The ControlFile Power Regulator 5 VDC and 12 VDC has LEDs to indicate card status. Figure 4.2.9 shows the LEDs and test points. Test points are accessible from the top of the ControlFile.



LEDs

+12 V POWER CHARGE (DS11)	Input capacitors are charging during card insertion with card cage power on. The proper procedure is to slowly insert the card into the ControlFile Motherboard connector (+12 AND +5 V Power Charge LEDs will blink on briefly).
+ 5 V POWER CHARGE (DS10)	Same as + 12 V Power Charge above.
INPUT B STATUS (DS9)	Bus B (24 VDC or 30 VDC) from the DC distribution system is within operating tolerance. Normally OFF if only one DC bus is used.
INPUT A STATUS (DS8)	Bus A (24 VDC or 30 VDC) from the DC distribution system is within operating tolerance.
−12 V STATUS (DS7)	The −12 VDC regulator is within operating tolerance. If HD2 is jumpered, DS7 is forced ON and −12 VDC is disabled.
+12 V STATUS (DS6)	The +12 VDC regulator is within operating tolerance.
+5 V STATUS (DS5)	The +5 VDC regulator is within operating tolerance.
CARD FAULT (DS4)	One of the regulator sections (+5, +12, −12 VDC) is out of operating tolerance. Replace the card.
12 V FUSE BLOWN (DS3)	Replace Fuse F1 (± 12 VDC supply sections of the Power Regulator).
5 V FUSE BLOWN (DS2)	Replace Fuse F2 (Power to the +5 VDC Power Regulator).
CARD GOOD (DS1)	+5, +12, and −12 VDC Supplies are within operating tolerance. Does not include status of the DC buses.

Test Points

BROWN	Ground return
BLUE	−12 VDC Regulator
YELLOW	+5 VDC Regulator
RED	+12 VDC Regulator
WHITE	+5 V Relative current indication
GREEN	+12 V Relative current indication

Figure 4.2.9. ControlFile Power Regulator 5 VDC and 12 VDC LEDs and Test Points

ControlFile Power Regulator 5 VDC and 12 VDC Jumpers

Model 1984–1505–000x can be jumpered for 30 volt or 24 volt DC input. This Power Regulator card should be jumpered for the 30 volt DC input unless it is necessary to use the 24 volt DC input to allow a +24 volt uninterruptible power supply source to tie in with a ControlFile.

The card can be jumpered to supply either 3 or 6 amps at 12 volts. Supplying 6 amps may put the –12 volt supply out of spec.

Figure 4.2.10 shows the jumper locations for the 1984–1505–000x Power Regulator card. Table 4.2.8 shows the jumper positions. Jumpers HD2 and HD3 use a bar that connects all pins. The bar should be on HD2 for 6 amp output and on HD3 for 3 amp output.

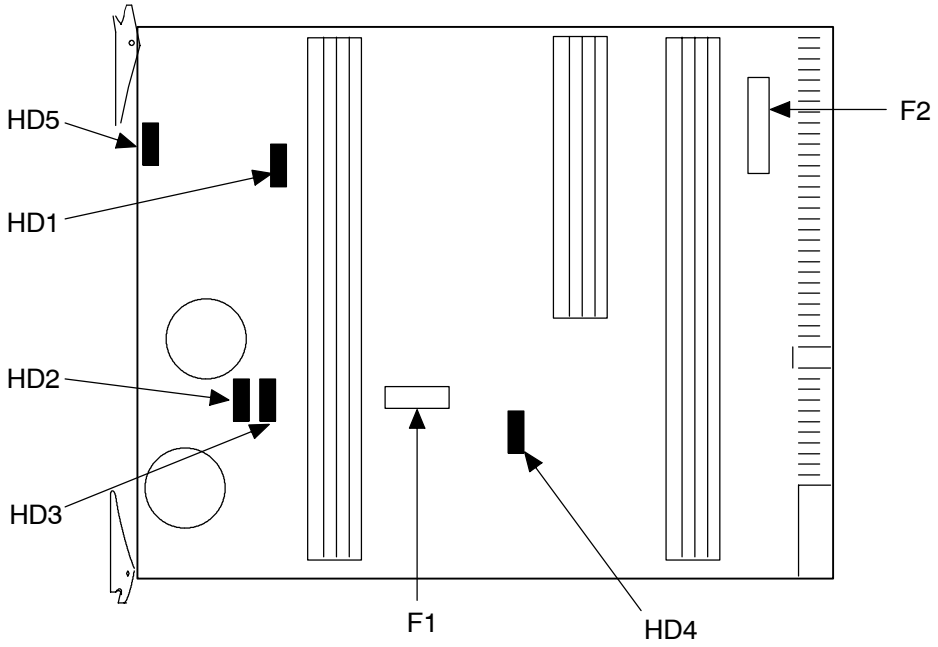


Figure 4.2.10. ControlFile Power Regulator 5 VDC and 12 VDC 1984–1505–000x Jumper and Fuse Locations

Table 4.2.8. ControlFile Power Regulator 1984-1505-000x Jumper Positions

Jumper	30 V Input	24 V Input	3 Amp Output	6 Amp Output
HD1	2-3	1-2		
HD2			Open	Bar
HD3			Bar	Open
HD4			1-2	2-3
HD5			1-2	2-3

ControlFile Power Regulator 5 VDC and 12 VDC Fuses

Figure 4.2.10 shows the 5 VDC and 12 VDC ControlFile Power Regulator fuse locations. Table 4.2.9 gives the fuse values and part numbers.

Table 4.2.9. ControlFile Power Regulator 5 VDC and 12 VDC Fuses

Fuse	FRSI Part No.	Bussman Part No.	Littelfuse Part No.	Characteristics
F1 (12 VDC)	G09140-0044	AGC 7-1/2	31107.5	7.5 A 32 V Regular
F2 (5 VDC)	G09140-0061	ABC 20	314020	20 A 250 V Regular

Coordinator Processor (CP)

The Coordinator Processor (CP) governs communications between Controller Processor cards and between the ControlFile and the PeerWay. The Coordinator Processor updates the nonvolatile memory database with current operating data and manages the downloading of program and operating data from nonvolatile memory to individual Controller Processors. When redundant Controller Processors are used, the Coordinator Processor determines which of the two is active and executes the actual exchange of control from one to another. The Coordinator Processor monitors status bits, PeerWay protocol, and communication with the (optional) redundant Coordinator Processor.

The Coordinator Processor is responsible for:

- Backing up Controller Processors
- Loading Controller Processors
- Controlling nonvolatile memory
- Communications on the PeerWay
- Communications between Controller Processors in the ControlFile
- Maintaining Links
- Running Batch

Coordinator Processor models are shown in Table 4.2.10.

Table 4.2.10. Coordinator Processors

Model	Part Number	Name	PWA Legend	Comment
CP5	10P57360007	Coordinator Processor 5	COORDINATOR PROCESSOR 5	EMC compliant
CP-IV+	10P5087000x	Coordinator Processor IV+	COORDINATOR PROCESSOR IV+	EMC compliant
CP-IV+	1984-4164-000x	Coordinator Processor IV+	COORDINATOR PROCESSOR IV+	
CP-IV	1984-4064-000x	Coordinator Processor IV	COORDINATOR PROCESSOR IV	
CP-II	1984-1594-000x	Coordinator Processor II	COORDINATOR PROCESSOR II	
CP-I	1984-1448-000x 1984-1240-000x	Coordinator Processor I	COORDINATOR PROCESSOR	

WARNING

Disable the NV Memory and then the Coordinator Processor cards before removing any card (other than a PeerWay Buffer card) from the ControlFile. Failure to do so may result in a corrupted data transfer.

Table 4.2.11 gives parts replacement data.

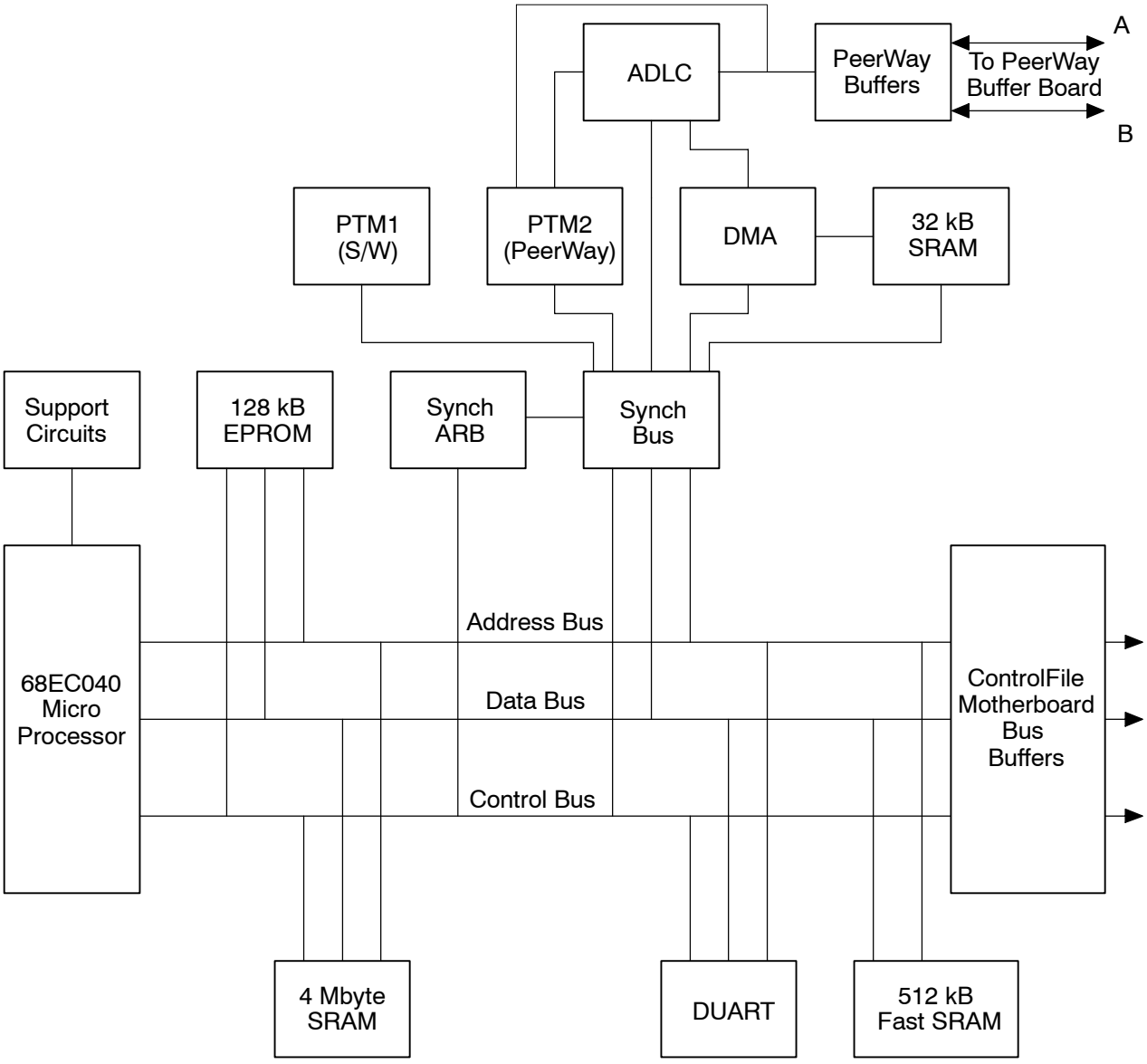
Table 4.2.11. Coordinator Processor Parts Replacement

Name	Part No.	Replaces	Characteristics
CP5	10P57360007	**NOTE:** For use with MPCII, MPC5, or a combination of MPCII and MPC5	EMC compliant 68040 microprocessor
CP-IV+	10P50870004	1984-4164-000x 1984-4064-000x **NOTE:** For use with MPCI, MPCII, MPC5, or a combination of MPCI and MPCII	EMC compliant 64 MHz oscillator; 4 Meg RAM; 68020 microprocessor
CP-IV+	1984-4164-000x	10P50870004 (except where EMC compliance is required) 1984-4064-000x **NOTE:** For use with MPCI, MPCII, MPC5, or a combination of MPCI and MPCII	64 MHz oscillator; 4 Meg RAM; 68020 microprocessor
CP-IV	1984-4064-000x	1984-4164-000x **NOTE:** For use with MPCII only	64 MHz oscillator; 4 Meg RAM; 68020 microprocessor
CP-II	1984-1594-000x	1984-1448-000x 1984-1240-000x	48 MHz oscillator; 512K RAM
CP-I	1984-1448-000x	1984-1240-000x	40 MHz Oscillator; 128K RAM
CP-I	1984-1240-000x		40 MHz Oscillator; 128K RAM

CP5 Circuit Description

The versions of the CP5 perform all the functions of the CP-IV and CP-II but have increased processor speed. A MC68EC040 microprocessor is used. CP5 will work with MPC5 or MPCII processors.

Figure 4.2.12 shows the functional diagram of a CP5 Coordinator Processor.



ADLC = Advanced Data Link Controller
ARB = Arbitration
DMA = Direct Memory Access
DUART = Dual Universal Asynchronous Receiver/Transmitter
EPROM = Erasable Programmable Read-Only Memory
SRAM = Static Random Access memory
S/W = Software
Synch = Synchronous

Figure 4.2.11. Coordinator Processor 5 (CP5) Block Diagram

The MC68EC040 microprocessor has a 32-bit architecture and a 48 MHz clock rate. The microprocessor support circuits provide a watchdog timer, clock generation circuitry, and an interrupt encoder. The microprocessor can interface with devices from 8 bits to 32 bits wide. It has an internal 4 kB instruction and data caches that speed up tight loops. The clock generation circuits provide 48, 24, and 2 MHz clocks for timing.

The 128 kB erasable programmable read-only memory (EPROM) provides the microprocessor boot program, power-up diagnostics, PeerWay boot program, and a debugger.

The 512 kB zero wait state fast static random access memory (SRAM) is organized into 32-bit words to hold programs, such as interrupt routines, that must run as fast as possible.

Four megabytes of static random access memory provides one megabyte of 32-bit working storage for the microprocessor.

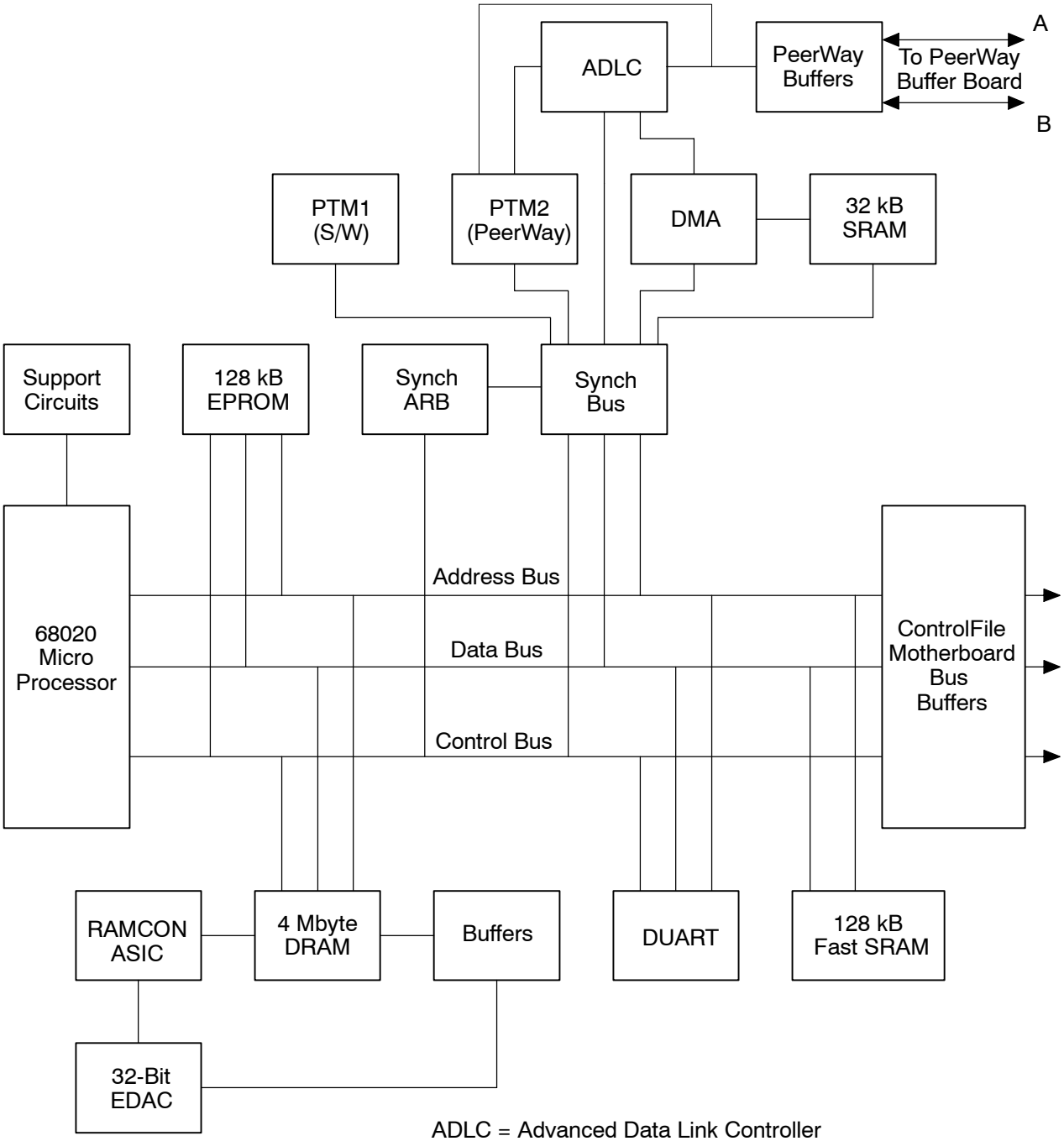
The synchronous bus provides a compatible interface between the microprocessor and the PeerWay for standard PeerWay communications. It also serves to interface the programmable timers (PTM), DMA controller, advanced data link controller (ADLC), and SRAM. Bus A arbitration circuit (ARB) controls access to the synchronous bus by either the DMA or the MC68EC040 microprocessor.

Buffers provide an interface with the standard ControlFile motherboard bus. This allows communications between the MC68EC040 processor on the CP5 and the processors that are on other cards in the ControlFile. There is also a 16-bit data path for communication between two redundant CP boards. This interface is identical to that used on CP-I, CP-II, and CP-IV.

CP-IV Circuit Description

The versions of the CP-IV perform all the functions of the CP-II but have increased memory and processor speed. A MC68020 microprocessor is used. CP-IV+ will work with MPC I processors, MPC5 processors, or MPC II processors. CP-IV works only with MPC II processors.

Figure 4.2.12 shows the functional diagram of a CP-IV Coordinator Processor.



ADLC = Advanced Data Link Controller
ARB = Arbitration
ASIC = Application Specific Integrated Circuit
DMA = Direct Memory Access
DRAM – Dynamic Random Access Memory
DUART = Dual Universal Asynchronous Receiver/Transmitter
EDAC = Error Detection and Correction
EPROM = Erasable Programmable Read-Only Memory
SRAM = Static Random Access memory
S/W = Software
Synch = Synchronous

Figure 4.2.12. Coordinator Processor IV (CP-IV) Block Diagram

The MC68020 microprocessor has a 32-bit architecture and a 16 MHz clock rate. The microprocessor support circuits provide a watchdog timer, clock generation circuitry, and an interrupt encoder. The microprocessor can interface with devices from 8 bits to 32 bits wide. It has an internal 256 byte instruction cache that speeds up tight loops. The clock generation circuits provide 32, 16, 8, 4, and 2 MHz clocks for timing. The 8 MHz clock is used for the PeerWay interface.

The 128 kB erasable programmable read-only memory (EPROM) provides the microprocessor boot program, power-up diagnostics, PeerWay boot program, and a debugger.

The 128 kB zero wait state fast static random access memory (SRAM) is organized into 32-bit words to hold programs, such as interrupt routines, that must run as fast as possible.

Four megabytes of dynamic random access memory (DRAM) provides one megabyte of 32-bit working storage for the microprocessor. Thirty-nine bits are used, thirty-two for data and seven for the EDAC check bits. The Error Detection And Correction (EDAC) scheme corrects single bit errors and detects multiple bit errors. The RAMCON ASIC provides for all of the timing requirements of the dynamic RAM chips and the EDAC circuitry.

The synchronous bus provides a compatible interface between the microprocessor and the PeerWay for standard PeerWay communications. It also serves to interface the programmable timers (PTM), DMA controller, advanced data link controller (ADLC), and SRAM. Bus A arbitration circuit (ARB) controls access to the synchronous bus by either the DMA or the MC68020 microprocessor.

Buffers provide an interface with the standard ControlFile motherboard bus. This allows communications between the MC68020 processor on the CP-IV and the processors that are on other cards in the ControlFile. There is also a 16-bit data path for communication between two redundant CP boards. This interface is identical to that used on CP-I and CP-II.

CP-I and CP-II Circuit Description

Figure 4.2.13 shows the functional diagram of a CP-I and CP-II Coordinator Processor. An on-card oscillator generates all timing required for card functions. The oscillator runs at either 40 MHz or 48 MHz, depending on the model used, and is divided down to various clock outputs distributed throughout the card.

The processor is a 68000 series (16-bit) microprocessor. Interrupts are prioritized according to importance so the tasks are handled in a reasonable order. A watchdog timer requires periodic resetting by the healthy processor or it will reset the micro. Buffering is provided on the card to the ControlFile motherboard for either the left or right motherboard bus, depending on which slot is selected.

An on-card bootstrap EPROM is provided that consists of two EPROMs arranged in 16-bit words. EPROMs store power-up diagnostics and the boot program required to download the operating program from nonvolatile memory to RAM or from the PeerWay by a PeerWay Boot procedure.

NOTE: The PeerWay Boot procedure may not be supported by all combinations of hardware and software.

The CP-I and CP-II Coordinator Processor contains dynamic RAM memory and error detection and correction (EDAC) control circuitry. The dynamic memory controller performs the required address multiplexing for the RAM chips and handles the refresh cycle. The dynamic RAM chips have separate pins for the read and write functions. A separate read/write select provides the separation and data bus buffering. The EDAC controller decodes the check bits that are stored along with the data bits. There are 16 data bits and six check bits. If any single bit is not as indicated by the EDAC check bits, the EDAC controller will automatically correct for the error and rewrite the data into the RAM location correctly. An alarm message is annunciated at the console to indicate a weak RAM bit.

If multiple bit errors are found, the EDAC triggers a bus error also annunciated at the console. Each dynamic RAM (2600) chip is arranged in a 64K x 1 bit pattern. A word in memory is 16 bits (8 bits to a byte, 2 bytes to a word) and 128K bytes are mapped to a 64K x (16 + 6) bits EDAC.

The positions of the node address jumpers are read into a buffer that stores the addresses. A second set of jumpers is configured identically for redundancy.

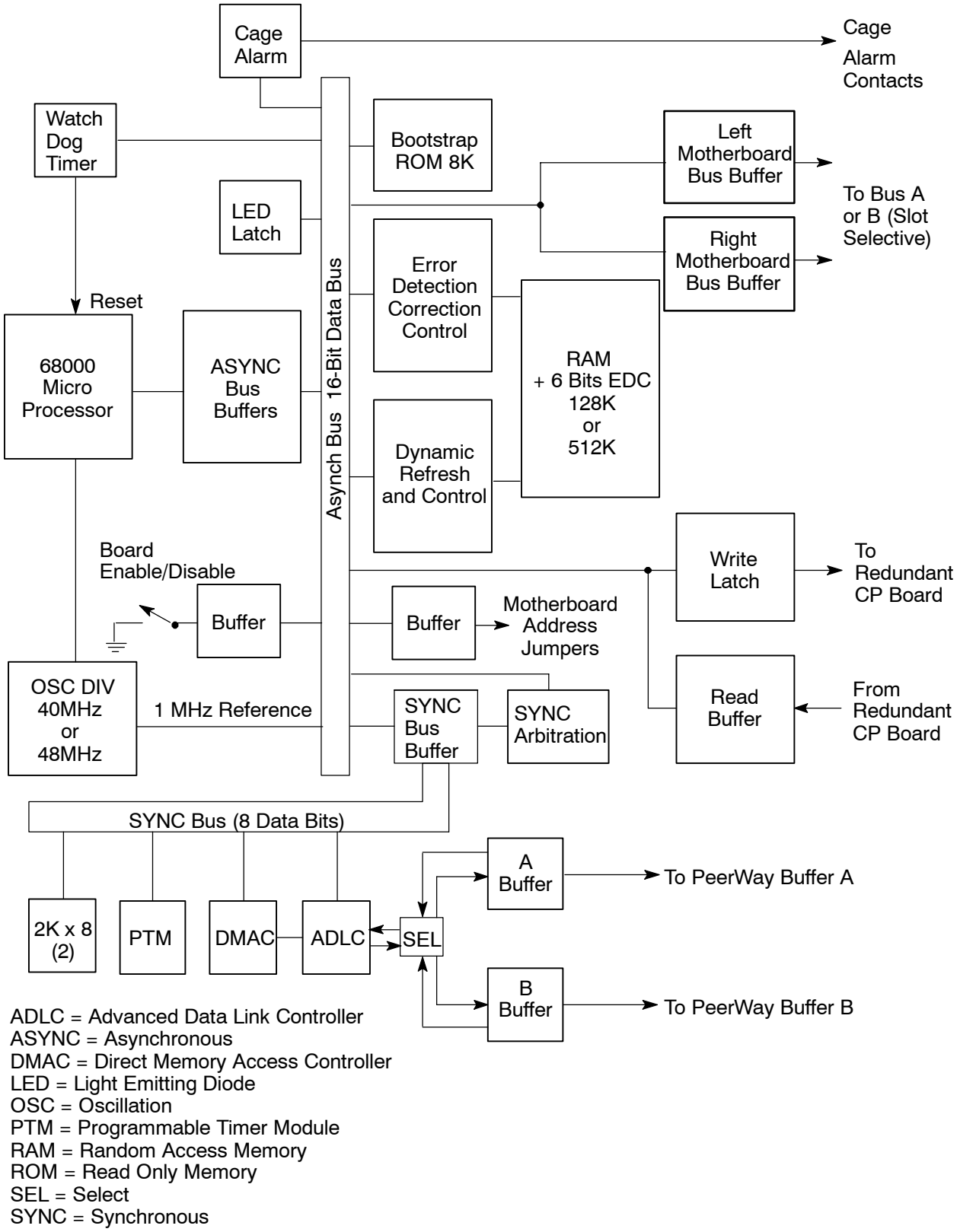


Figure 4.2.13. CP-I and CP-II Coordinator Processor Functional Diagram

The 68000 series microprocessor is an asynchronous device, operating on a 10 or 12MHz clock. The peripheral chips used on the Coordinator Processor, including the PTM, DMAC, and ADLC are synchronous devices, operating at a maximum of 2 MHz. These synchronous devices interface to the asynchronous bus through a separate internal synchronous bus. The synchronous bus is 8 bits wide, and interfaces to the processors' lower 8 bits for the PeerWay buffer. Address and bidirectional data bus buffers transfer information to be communicated on the PeerWay into special buffer RAM. This RAM size is 4K x 8. Data is then transferred through the direct memory access controller (DMAC) to the advanced data link controller (ADLC) where the information is transformed to NRZ serial data. Data is then transferred to either the A or B PeerWay Buffer. The programmable timer modules (PTMs) are used for the bus access scheme that performs time-out functions. This allows other devices to access the bus at given times.

CP (Coordinator Processor) Redundancy

Coordinator Processors (CP) are made redundant simply by adding a second unit. The CPs must be of the same type.

One CP will become the primary processor; the other will be the secondary. Many events can cause a switch in roles between the primary and secondary CP. When a switch occurs, the secondary CP becomes primary and the primary becomes the secondary CP.

The primary CP will allow the secondary CP access to the controllers once every minute to allow it to talk to all controllers.

If the error statistics on the primary CP are worse than the secondary, the secondary CP will switch to the primary and an appropriate alarm will be generated.

All errors and conditions that cause a CP switchover are prioritized. If both CPs have active error conditions, the one with the lowest priority error will act as primary. For instance, if the primary CP develops a weak RAM chip, the secondary will switch in as primary. If the new primary then develops a higher priority error, the CP with the weak RAM chip will take over again.

Each CP has its own dedicated data bus to communicate with power supplies, nonvolatile memory, and all controllers. All cards, other than the CP and the PeerWay Buffers, have two sets of buffers for addresses and data. Thus, should an open or short happen on any card, the redundant CP can still operate unaffected.

Although the two Coordinator Processor boards operate on different buses, they must still communicate with each other. A dedicated communications bus is provided to allow redundant Coordinator Processors to communicate directly with each other. Each Coordinator Processor has dedicated 16-bit wide read and write buffers that are used to transfer data between Coordinator Processors. The redundant Coordinator Processors also use the static RAM area in the NV Memory to exchange information.

Messages from the primary CP are deposited in the nonvolatile memory. Then, while the primary CP is communicating with the controllers, the secondary CP accesses the nonvolatile memory, reads the message, and leaves its message for the primary CP.

The conditions that cause a CP switch are:

- The operator performs a manual switch from the ControlFile Status screen.
- The primary CP no longer communicates with the backup CP.
- The primary CP communicates with the backup CP but has a higher priority error condition than the backup CP. CP error conditions, listed in decreasing priority, are:
  - Backplane data integrity error
  - PeerWay health
  - Primary CP cannot see all controllers
  - ROM checksum error
  - RAM EDAC error
  - Error in the watchdog timer circuit

To prevent endless switching between CPs, no more than two nonmanual CP switches are allowed in a 5.5 minute period.

The PeerWay Node screen will display the PeerWay statistics and errors for the primary CP. Pressing the [EXCHG] key will display the statistics and errors of the Redundant CP.

A CP can be disabled by use of the Enable/Disable Switch.

In order to troubleshoot, you may need to remove the cards from the ControlFile one at a time or move the other CP to the suspected faulty slot.

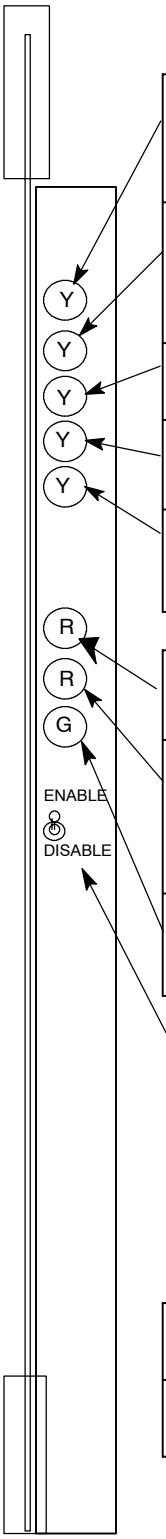
CP LEDs, Test Points, and Enable/Disable Switch

The Coordinator Processor has LEDs to indicate card status. Figure 4.2.14 shows the CP LEDs and test points.

The Enable/Disable Switch turns the CP on and off. The Enable/Disable Switch can be used as follows during operation:

- If a primary CP (with redundant backup) is disabled, the primary CP goes out of service. The backup CP assumes control. If the Nonvolatile Memory is not present and enabled, some information will be lost when the primary CP goes out of service. Loss of information is critical with enhanced CP images such as $$CPBATxx or $$CPMAXxx.
- If a primary CP (with no backup) is disabled, all communications between CPs in the ControlFile and between the ControlFile and the PeerWay will halt. Processing will resume when the switch is enabled, but only after the CP passes power-up diagnostic tests and data is downloaded from the Nonvolatile Memory.
- If a redundant backup CP is disabled, the backup ceases to perform background tests and tells the primary CP that it is out of service. It can return to backup status after it passes power-up diagnostic tests and after data is downloaded from the Nonvolatile Memory.

NOTE: If the CP switch is disabled and then quickly enabled, the CP may refuse to boot up. Wait for the red LED to come on before throwing the switch again.



LEDs

TIC (DS10)	Flashes at the beginning of a new time interval counter period (one tic is 1/4 second). The system operates on a 1/4 second data transfer rate for all PeerWay nodes (electrical drops).
CONT (DS9)	The Coordinator Processor is communicating with a Controller via the Motherboard. With redundant Coordinator Processors, this LED indicates which one is active.
BUS A (DS8)	The Coordinator Processor is using PeerWay A to transmit or receive data.
BUS B (DS7)	The Coordinator Processor is using PeerWay B to transmit or receive data.
RTS PEERWAY (DS6)	The Ready-To-Send signal is active and data should be transmitting on one of the two PeerWays.
5 V FUSE BLOWN (DS3)	Replace Fuse F1 (supplies 5 VDC to the Coordinator Processor).
CARD FAULT (DS2)	A fault has been detected on the Coordinator Processor, or the Enable/Disable Switch is in the DISABLE position. If the switch is ENABLED and this LED is on, replace the Coordinator Processor.
CARD ENABLE (DS1)	The Enable/Disable Switch is ENABLED and no hardware faults are detected on the Coordinator Processor.

Enable/Disable Switch

Test Points

Yellow	5 V (± 0.1 V)
Brown	Ground Return

Figure 4.2.14. Coordinator Processor LEDs and Test Points

CP LED Sequences

Normal operation of the CP card is signified by the green LED being ON and the yellow LEDs flashing.

The red LED will be ON when the Enable/Disable switch is in the Disable position or if a fault has been detected.

The Coordinator Processor Power Up Sequence begins when the Enable/Disable switch is placed in the ENABLE position. For a successful power up test the red LED comes ON, the yellow LEDs cycle, the red LED goes OFF, and the green LED comes ON.

A power up fault is indicated by the green LED lighting briefly, followed by the red LED turning ON. The yellow LEDs will cycle, stop briefly, and cycle again. The top four yellow LEDs are counting in hex from 1 to 15. The fault condition can be found by comparing the yellow LED pattern at the pause with those shown in Table 4.2.12 and Table 4.2.13.

When the Coordinator Processor passes the power up diagnostics, it then requests a program load from the Nonvolatile Memory. If it cannot access the nonvolatile memory, all of the yellow LEDs will flash simultaneously approximately once per second. This indicates that the Coordinator Processor is waiting for a disk PeerWay boot. Check to see that the Nonvolatile Memory is enabled and properly seated.

Table 4.2.12. CP Fault Indications: Green LED OFF, Red LED ON

Yellow LED Conditions	Fault Condition
OFF OFF OFF **ON** OFF	1. CPU Test fault
OFF OFF **ON** OFF OFF	2. Boot ROM Checksum fault
OFF OFF **ON** **ON** OFF	3. Vector Test fault
OFF **ON** OFF OFF OFF	4. Watchdog Timer fault
OFF **ON** OFF **ON** OFF	5. Nondestructive RAM
OFF **ON** **ON** OFF OFF	6. Destructive RAM Test or EDAC fault
OFF **ON** **ON** **ON** OFF	7. Synch Bus Test Level 1 & 2 and checks on interrupts

Table 4.2.13. CP Fault Indications: Green LED ON Then OFF, Red LED ON

Yellow LED Conditions	Fault Condition
ON OFF OFF OFF OFF	1. Nonvolatile Memory write test failed before the PeerWay boot procedure was performed. The Nonvolatile Memory card should be replaced.
ON OFF OFF **ON** OFF	2. No Nonvolatile Memory card is present or the Nonvolatile Memory card switch is in the DISABLE position.
ON OFF **ON** OFF OFF	3. Checksum invalid after load. If the problem persists, a nonvolatile memory reload from disk may be necessary.
ON OFF **ON** **ON** OFF	4. Uncorrectable error detected in CP card communications. The CP card should be replaced.
ON **ON** OFF OFF OFF	5. Nonvolatile memory initialize failed. Nonvolatile Memory card problem. See Chapter 10, “Troubleshooting”.
ON **ON** OFF **ON** OFF	6. Nonvolatile memory table checksum bad. Nonvolatile Memory card problem. See Chapter 10, “Troubleshooting”.
ON **ON** **ON** OFF OFF	7. No program image stored in the nonvolatile memory. See Chapter 10, “Troubleshooting”.
ON **ON** **ON** **ON** OFF	8. Nonvolatile Memory card hardware error on read. If the Nonvolatile Memory card was enabled, the card should be replaced.

CP Jumpers

The Coordinator Processor variations are:

- CP5
- CP-IV+
- CP-IV
- CP-II
- CP-I

CP5 (10P57360007)

CP5 may be used with MPCII and MPC5 Controller Processors. It does not have any jumpers.

CP-IV+ (10P50870004 and 1984-4164-0004)

CP-IV+ may be used with MPCI, MPCII, MPC5, CC, MLC, MUX, SSC, and PLC Controller Processors. It has one moveable jumper. Table 4.2.14 shows the jumper positions for CP-IV+.

Table 4.2.14. CP-IV+ Jumper Positions

Jumper	Position	Function
HD3 to HD6	1-2	Factory set - do not move
HD7	MPCII or MPC5 (1-2)	Working with MPCII or MPC5 Controller Processors only (Factory Setting)
	OTHER (2-3)	Working with a mix of MPCI, CC, MLC, MUX, SSC, and PLC Controller Processors.

Figure 4.2.15 shows fuse and jumper locations.

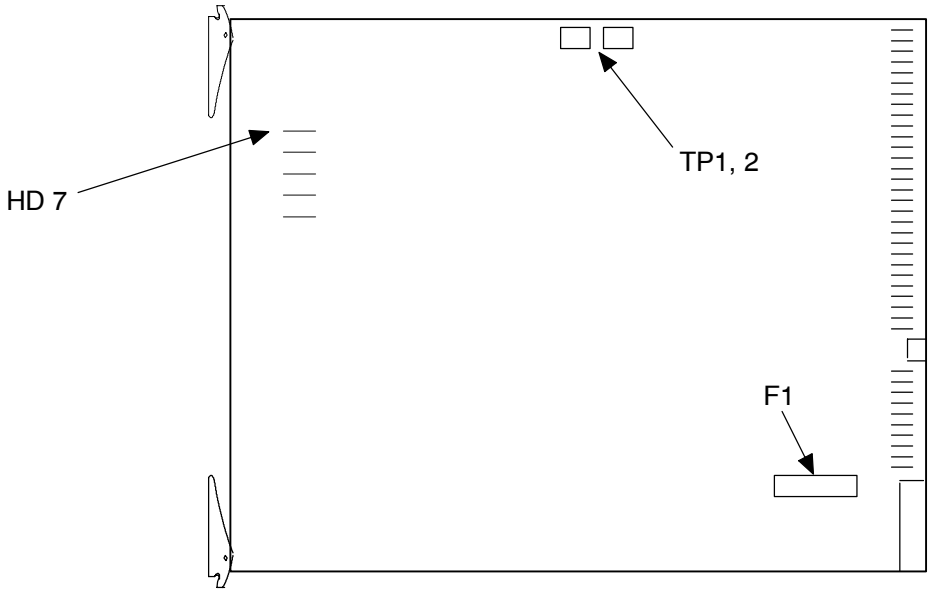


Figure 4.2.15. CP-IV and CP-IV+ Fuse and Jumper Locations

CP-IV (1984-4064-000x)

CP-IV may be used only with MPC II Controller Processors. It has no field adjustable jumpers.

Figure 4.2.15 shows fuse and jumper locations. Table 4.2.15 shows the jumper positions for CP-IV. HD1, HD2, and HD8 are hardwired. HD3 through HD6 are factory set to 1-2 and should not be moved.

Table 4.2.15. CP-IV Jumper Positions

Jumper	Position	Function
HD3 to HD6	1-2	Factory set - do not move

CP-II (1984-1594-000x)

CP-II has Jumpers HD8 and HD16, which are adjustable for the basic $$CPxxxx operating program being loaded. The remainder of the jumpers are factory set and should not be moved. Figure 4.2.16 shows the jumper positions for CP-II. Table 4.2.16 shows the software jumper positions. Set the other jumpers as shown in Table 4.2.17.

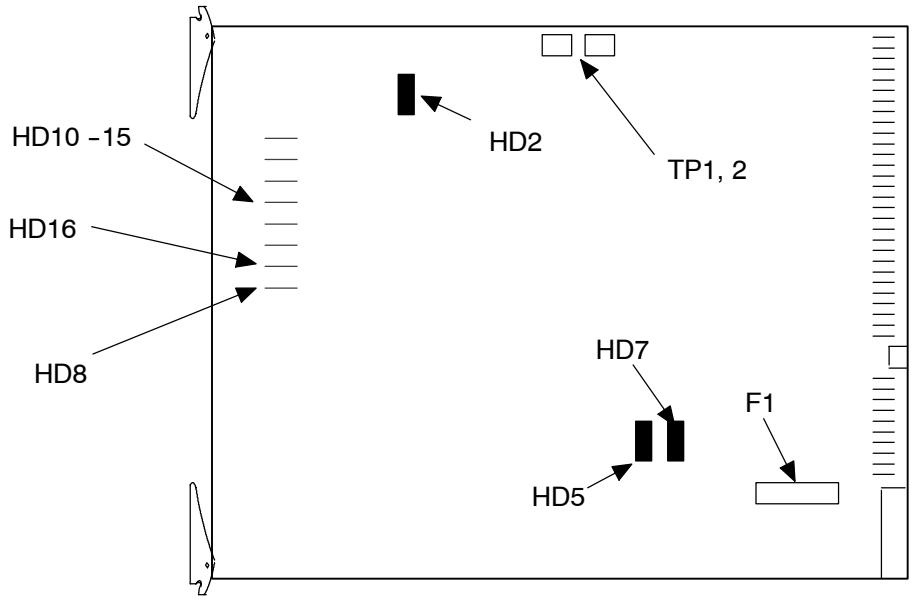


Figure 4.2.16. CP-II Fuse and Jumper Locations

Table 4.2.16. CP-II Software Jumper Positions

Software	Jumper HD8	Jumper HD16
$$CPBATxx	2-3	2-3
$$CPxx V9	1-2	1-2
$$CPMAXXxx V9 and above $$CPxx V11 and above	2-3	1-2

Table 4.2.17. CP-II Factory Set Jumpers

Jumper	Position
HD2	2-3
HD5	1-2
HD7	1-2
HD10 through HD15	Open

CP-I (1984-1448-0001 or 1984-1240-0001)

CP-I has no field adjustable jumpers. The jumpers are factory set and should not be moved. Jumpers HD2 and HD5 are set to 2-3. Jumper HD7 is set to 1-2. Figure 4.2.17 shows fuse and jumper locations. Table 4.2.18 shows the jumper positions.

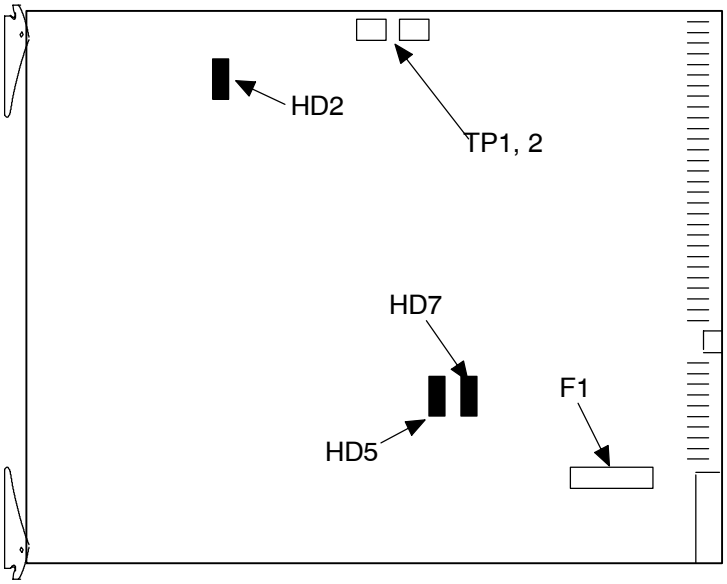


Figure 4.2.17. CP-I Fuse and Jumper Locations

Table 4.2.18. CP-I Factory Set Jumpers

Jumper	Position
HD2	2-3
HD5	2-3
HD7	1-2

CP Fuses

Figure 4.2.17 shows the fuse location. Table 4.2.19 gives fuse values for the Coordinator Processors.

Table 4.2.19. CP Fuses

Card	Fuse	FRSI Part No.	Bussman Part No.	Littelfuse Part No.	Characteristics
CP5 10P57360007	F1	G09140-0037	AGC 4	311004	4 A 32 V Regular
CP-IV+ 10P50870004 1984-4164-0004	F1	G09140-0041	MTH 5	312005	5 A 250 V Regular
CP-IV 1984-4064-0004	F1	G09140-0041	MTH 5	312005	5 A 250 V Regular
CP-II 1984-1594-0001	F1	G09140-0039	AGC 5	311005	5 A 32 V Regular
CP-I 1984-1448-0001	F1	G09140-0037	AGC 4	311004	4 A 32 V Regular
CP-I 1984-1240-0001	F1	G09140-0037	AGC 4	311004	4 A 32 V Regular

NV (Nonvolatile) Memory

The Nonvolatile Memory is available in two forms:

Table 4.2.20. Nonvolatile Memory Cards

Type	Name	Part No.	PWA Legend
RAM	RAM Nonvolatile Memory	1984-2347-00xx	NV MEMORY
Bubble	Bubble Nonvolatile Memory	1984-1598-0001	NV BUBBLE MEMORY
		1984-1483-0001	NV BUBBLE MEMORY
		1984-1224-000x	NV BUBBLE MEMORY

The two forms differ in speed, available memory size, and in the mechanism used to provide the nonvolatile memory. The RAM Nonvolatile Memory card uses battery-backed SRAM whereas the Bubble Nonvolatile Memory card uses Magnetic Bubble Memory (MBM) modules.

The Nonvolatile Memory card is responsible for:

- Storing the CP operating program.
- Storing operating programs for each Controller.
- Providing backup storage for the Plant Configuration.

CAUTION

Disable the NV Memory and then the Coordinator Processor cards before removing any card (other than a PeerWay Buffer card) from the ControlFile. Failure to do so may result in a corrupted data transfer.

The Nonvolatile Memory is an extension of the memory on the Coordinator Processor. Nonvolatile memory is capable of storing data without power being applied, yet can be readily changed when power is applied. It stores the operating program and configuration data for the Coordinator Processor(s). There is also space for the configuration data of nine Controller Processors. This space consists of configurations for up to eight Controller Processors and one extra working file so that the last file is not deleted until a new one is completed. The data can be downloaded through the PeerWay from a disk or the card may be shipped with configuration data already loaded. A memory map for all data is stored in the nonvolatile memory header table in the nonvolatile memory.

Once the Coordinator Processor is through its startup diagnostics, it uses its boot ROM to download (read) the operating program from the Nonvolatile Memory. The Coordinator Processor then accesses the RAM on each Controller Processor in turn and downloads (writes) the operating and configuration program to each.

Periodically the Coordinator Processor takes a snapshot of the configuration and dynamic data in each Controller Processor and transfers it to nonvolatile memory. As a result, if a power loss occurs, the Controller Processor can be restarted with accurate data. The Nonvolatile Memory has dual port buffers so it can be controlled by either Coordinator Processor card (if redundant Coordinator Processor cards are used).

The card cage has two slots for nonvolatile memory cards. These are not intended for redundancy but are useful during troubleshooting and recovery from a “Nonvolatile Memory” or “Bubble Memory” fault.

There are several versions of the Nonvolatile Memory card. Table 4.2.21 covers parts replacement data.

NOTE: Only RAM NV Memory cards may be used in a ControlFile that uses the 5 V Only Power Regulator.

Table 4.2.21. Nonvolatile Memory Parts Replacement

Part No.	Replaces	Memory	Board Marked
1984-2347-0041	--	4 Megabyte RAM	NV MEMORY
1984-2347-0021	Any card below	2 Megabyte RAM	NV MEMORY
1984-2347-0011	Any card below	1 Megabyte RAM	NV MEMORY
1984-1598-0001	Any card below	1 Megabyte Bubble	NV BUBBLE MEMORY
1984-1483-000x	1984-1224-000x	1/2 Megabyte Bubble	NV BUBBLE MEMORY
1984-1224-000x	--	1/2 Megabyte Bubble	NV BUBBLE MEMORY

RAM NV Memory

The RAM Nonvolatile memory uses a 16 MHz MC68000 microprocessor. All functions of the Bubble Nonvolatile Memory are duplicated by the microprocessor, which makes the RAM card a fully qualified replacement for the bubble card. The RAM card reads and writes at approximately twice the speed of the bubble card. Figure 4.2.18 shows a functional diagram of the RAM Nonvolatile Memory.

Bus arbitration circuitry controls which ControlFile bus will be used for each transaction. Addresses sent by the Coordinator Processor are translated from those used with the bubble memory to those used with the RAM. This allows a RAM card to replace a bubble memory card.

The MC68000 microprocessor simulates the actions of the bubble card. A 64K EPROM is used to hold the microprocessor boot and power-up diagnostic programs and holds the operating program of the NV Memory. A 64K program RAM supplies the microprocessor with program memory and working storage. A watchdog timer is provided to ensure against hangups of the microprocessor.

CAUTION

Disable the NV Memory and then the Coordinator Processor cards before removing any card (other than a PeerWay Buffer card) from the ControlFile. Failure to do so may result in a corrupted data transfer.

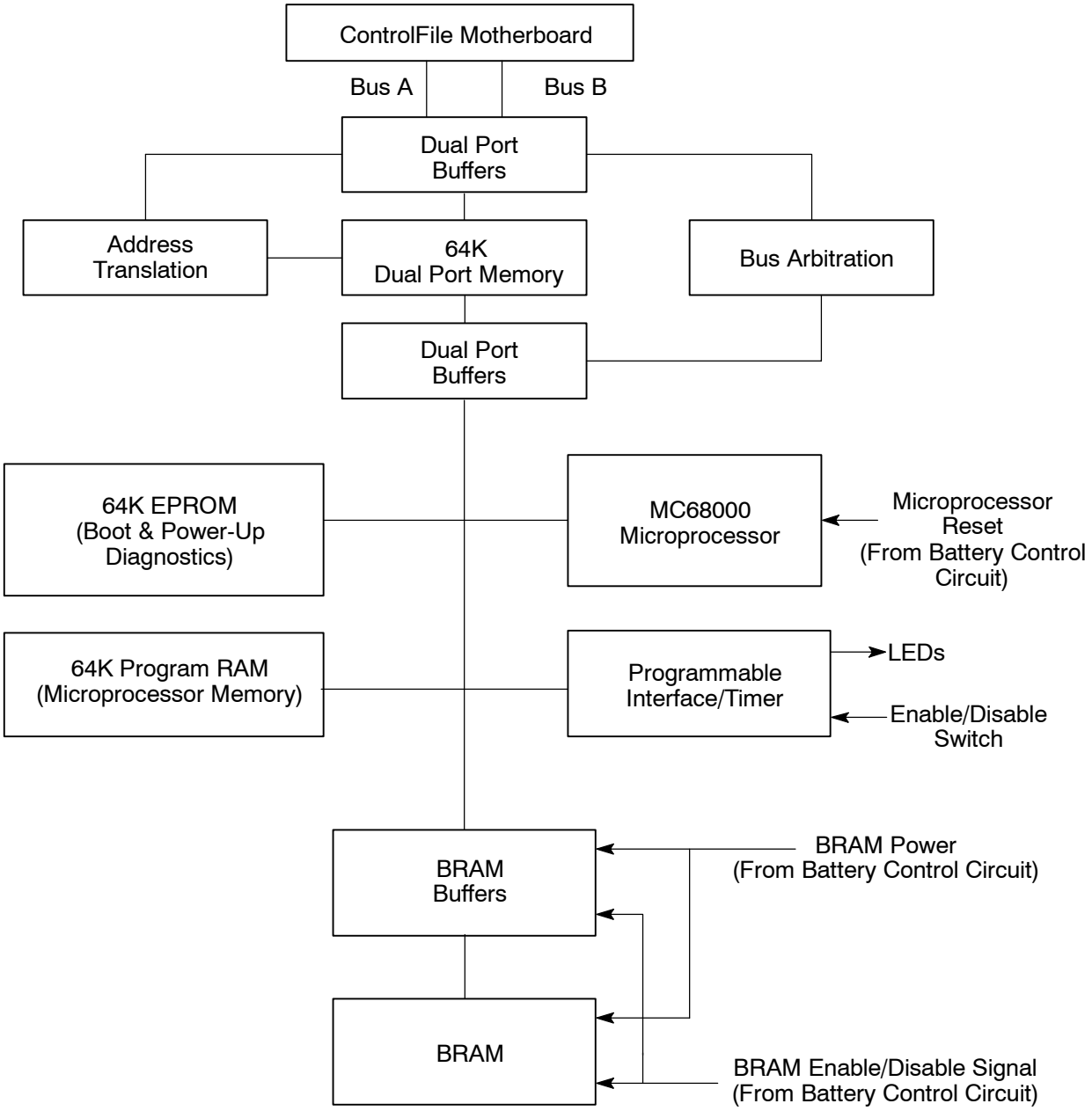


Figure 4.2.18. RAM Nonvolatile Memory Block Diagram

Figure 4.2.19 shows the battery control circuit. The battery control circuit monitors the +5 VDC supply and the battery voltages. If the +5 VDC supply falls below the threshold value, the battery control circuit preserves the contents of the battery backed random access memory (BRAM):

- Causes the microprocessor to issue an alarm to the Coordinator Processor.
- Signals the microprocessor to halt reads and writes to the BRAM.
- Disables the BRAM, to prevent further reads or writes.
- Supplies the BRAM with power from the batteries.

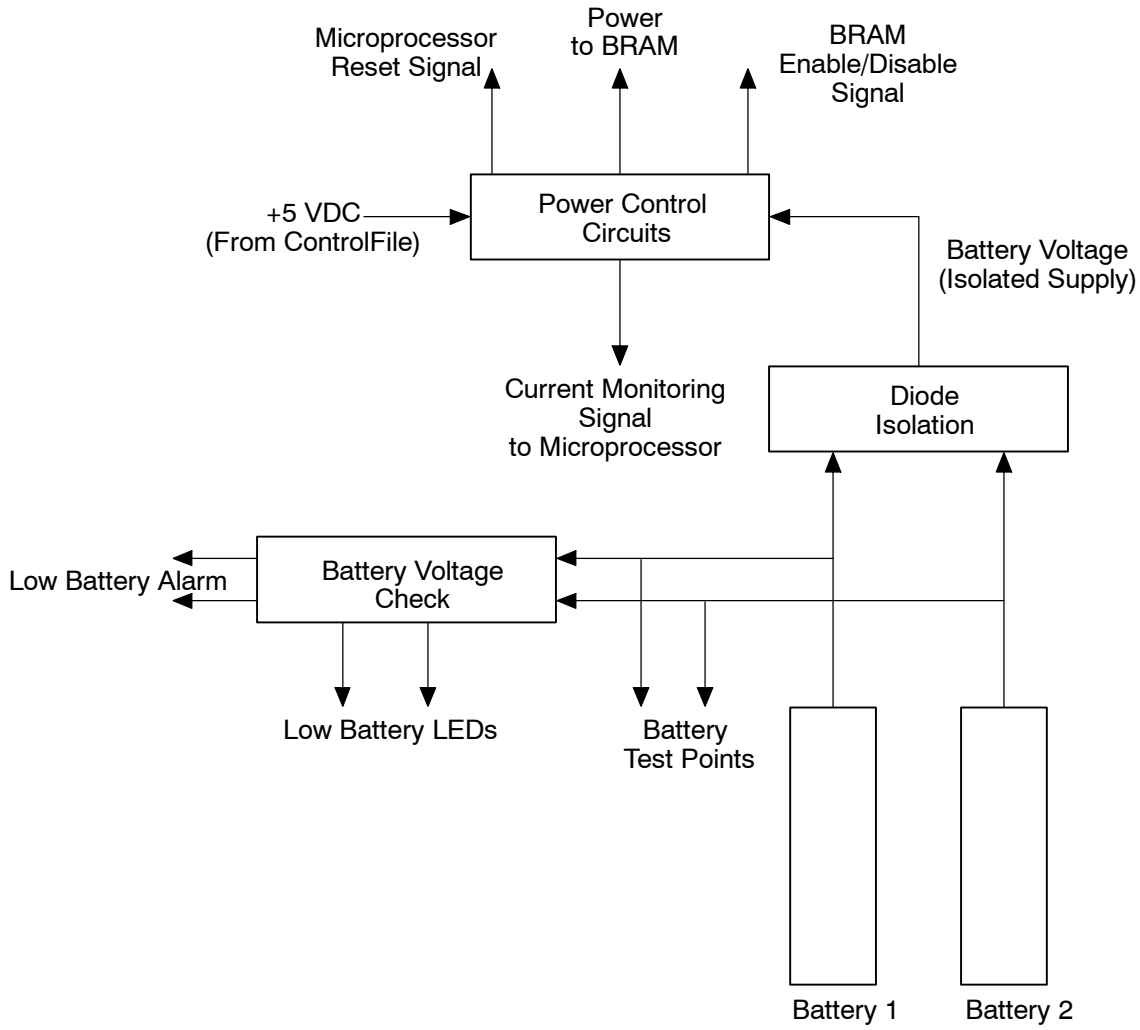


Figure 4.2.19. RAM NV Memory Battery Control Circuit

When the +5 VDC supply raises to the threshold level, the battery control circuit acts to restore normal BRAM operation.

The battery control circuit continuously monitors the voltage of each battery. If a battery voltage falls below the limit, a Low Battery Alarm is generated to the Coordinator Processor and the proper Low Battery LED is lighted. Test points are provided to allow direct measurement of battery voltage.

The microprocessor initiates a BRAM current draw test once every 24 hours. The current used by the BRAM is measured and reported by the battery control circuit. This can be used to detect static electricity damage to BRAM cells or other abnormal BRAM power conditions. Damaged cells typically draw a much larger current than do normal cells.

Two 3.6 V AA size lithium batteries are used. The batteries were selected for their reliability and long life. New batteries can maintain the RAM in continuous data retention mode for approximately the times listed in Table 4.2.22. The batteries should be disabled if the RAM NV Memory is not being used for data retention and normal +5 VDC is not available. This prevents unnecessary discharge of the batteries.

Table 4.2.22. RAM NV Memory Retention

RAM Size	Data Retention
1 Meg	4 years
2 Meg	2.5 years
4 Meg	1.25 years

Because RAM cells that have been damaged by static electricity discharge draw considerably more power than undamaged cells, it is possible that battery drain in the standby condition can be much higher than normal. This can result in shortened battery life. A RAM NV Memory card that shows an abnormal BRAM current draw should be returned to the factory for repair.

If a battery requires replacement, both batteries should be replaced and the battery manufacture date entered on the label area provided on the board. Remove one battery at a time to allow the other battery to power the RAM. It is recommended that a disk backup be made of the ControlFile static data prior to changing the batteries.

A PeerWay boot of the Coordinator Processor will be required when a RAM NV Memory card is installed unless the RAM already contains the required software. A PeerWay boot will also be required if the RAM is somehow erased.

RAM NV Memory LEDs and Test Points

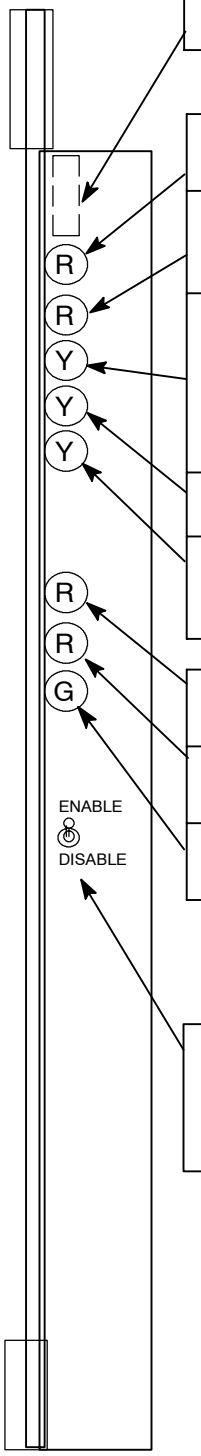
Figure 4.2.20 shows the LEDs Test Points, and the Enable/Disable Switch on the RAM Nonvolatile Memory. LED sequences are shown in the next paragraph.

Test Points

Brown	Ground Return
Yellow	+5 VDC
Green	Voltage of Battery # 2
White	Voltage of Battery # 1

LEDS

BATTERY 2 LOW (DS10)	Battery 2 voltage is low. Replace both batteries. (One at a time)
BATTERY 1 LOW (DS9)	Battery 1 voltage is low. Replace both batteries. (One at a time)
PROGRAM ACCESS (DS8)	The Coordinator Processor is accessing the main operating programs of a Controller Processor or itself. The CP is reading from Nonvolatile Memory to download data to a card, or is writing to the Nonvolatile Memory from the ControlFile.
WRITE (DS7)	The Nonvolatile Memory is being written to by the Coordinator Processor.
READ (DS6)	The Nonvolatile Memory is being read by the Coordinator Processor.
+5 VDC BAD (DS3)	Replace Fuse F1.
CARD BAD (DS2)	Enable/Disable switch is at DISABLE or the card failed power-up diagnostics.
CARD GOOD (DS1)	Card passed power-up diagnostics.



Enable/Disable Switch

The Enable/Disable Switch is read by the Coordinator Processor during operation. The result is that it knows when it can or cannot access the Nonvolatile Memory. Nonvolatile memory functions resume when the switch is enabled and the card has successfully passed power-up diagnostic tests.

Figure 4.2.20. RAM NV Memory LEDs, Test Points, and Enable/Disable Switch

RAM NV Memory LED Sequences

Normal operation of the RAM NV Memory is signified by the green LED being ON and the yellow LEDs flashing.

The red “Card Bad” LED will be on when the Enable/Disable Switch is in the DISABLE position or if the card has failed power-up diagnostics.

The RAM NV Memory power-up sequence begins when the battery control circuit detects restoration of +5 VDC. A power-up test sequence may take up to 1 minute and 40 seconds, depending on the memory size and the condition of the RAM. First the power-up diagnostics are performed and then a memory check is run.

The red “Card Bad” LED will be ON during the power-up diagnostics. The yellow LEDs will flash as the tests are run.

If the power-up tests fail, the red “Card Bad” LED will stay ON. The yellow status LEDs will flash as the power-up tests are run. A pattern will hold in the yellow LEDs for a second or two and then the sequence will repeat. The pattern indicates which power-up test failed. Table 4.2.23 shows the pattern and its meaning.

The RAM is checked next. The red and green LEDs will flash alternately and all of the other LEDs will blink. A Cyclical Redundancy Check (CRC) is made on each block of RAM and the result is compared with a stored value. If the CRC check fails, the block of memory is cleared. When this memory scrubbing operation is completed, the red “Card Bad” LED will go OFF, the green LED will go ON, and the yellow LEDs will flash as the card performs its normal functions.

If the red LED goes off and the yellow LEDs do not flash, the card has no images. Download new images. The yellow LEDs will flash and the card will run normally when the download is completed.

A low battery is indicated by either of the two red “Battery Low” LEDs being ON.

If the red “Card Bad” LED and the green LED are flashing alternately:

- One battery is low.
- BRAM chips have been swapped out due to a bad SRAM chip.
- The current draw of the battery backed RAM is too high.

Replace the batteries or the card as soon as is practical.

Table 4.2.23. RAM NV Memory LED Sequences

Yellow LED Pattern	Fault Condition: Red "Card Bad" LED ON Green LED OFF
OFF OFF OFF	0. MC68000 Microprocessor test
OFF OFF **ON**	1. EPROM checksum test
OFF **ON** OFF	2. Program & Dual Port ROM test
OFF **ON** **ON**	3. Watchdog Timeout test
ON OFF OFF	4. Not used
ON OFF **ON**	5. Interrupt test
ON **ON** OFF	6. Parallel Interface test
ON **ON** **ON**	7. Not used

RAM NV Memory Jumpers

Figure 4.2.21 shows the location of the jumpers on the NV RAM card. Table 4.2.24 gives the battery jumper settings. The batteries should be disabled only if memory backup is not desired. Table 4.2.25 shows the other jumper locations. Jumper HD3 is factory set at 1–2 but is not presently used by the software.

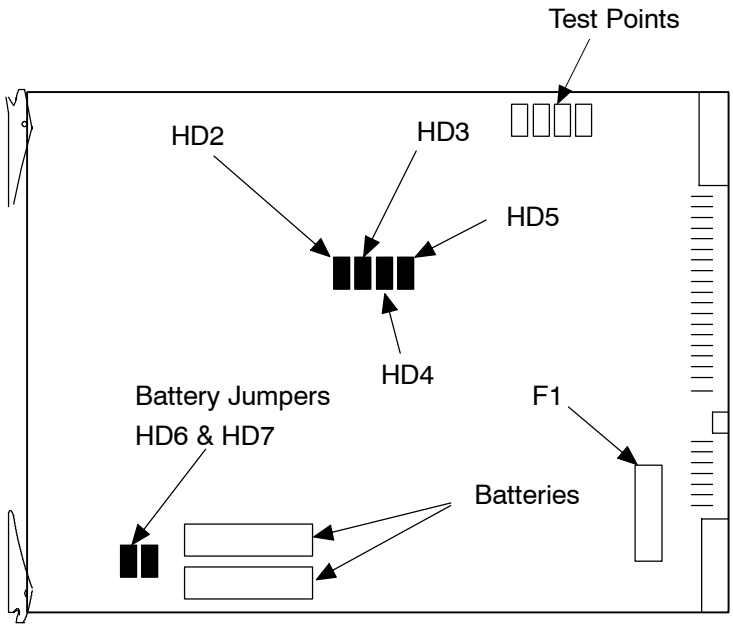


Figure 4.2.21. RAM NV Memory Fuse, Jumper, and Test Point Locations

Table 4.2.24. RAM NV Memory Battery Jumper Positions

Jumper	Position	Action
HD6	1–2	Battery 2 enabled
	2–3	Battery 2 disabled
HD7	1–2	Battery 1 enabled
	2–3	Battery 1 disabled

Table 4.2.25. RAM NV Memory Jumper Positions

Card	HD3	HD4	HD5	Characteristic
1984–2347–0011	1–2	1–2	1–2 Hard wired	1 Meg RAM
1984–2347–0021	1–2	2–3	1–2 Hard wired	2 Meg RAM
1984–2347–0041	Hard wired	2–3 Hard wired	2–3 Hard wired	4 Meg RAM

RAM NV Memory Battery Replacement

The batteries should be replaced periodically or whenever one of the Low Battery LEDs lights. Replace both batteries but disable them one at a time to allow the other to retain the RAM contents. Use only 3.6 volt lithium batteries (G52932-0002).

❑ **To replace the batteries:**

NOTE: Backup to disk before you remove the NV memory card for battery replacement. Follow recommended procedures in powering down the ControlFile (see below). Use static protection whenever handling the NV RAM.

CAUTION

If one battery is low, replace the low battery first to ensure data retention.

1. Disable the battery by moving the jumper to 2-3 (“OFF”). Jumper HD7 is for battery one, HD6 is for battery two.
2. Remove and replace the battery. Mark the date of battery manufacture on the “BT1 DATECODE” label area.
3. Enable the battery by moving the jumper back to 1-2 (“ON”).
4. Repeat for battery two, using the other jumper.

RAM NV Memory Fuse

Figure 4.2.21 shows the location of the fuse on the RAM Nonvolatile Memory card. Table 4.2.26 gives fuse data.

Table 4.2.26. RAM NV Memory Fuse Data

Fuse	FRSI Part No.	Bussman Part No.	Littelfuse Part No.	Characteristics
F1	G09140-0037	AGC 4	311004	4 A 32 V Regular

NV Memory and Powering Down the ControlFile

Perform the Disk Shutdown (DS) command before powering down the console. This will purge the cache and prevent possible loss of data.

First disable the NV Memory card and then the primary and secondary Coordinator Processor cards by placing the ENABLE/DISABLE switches to the DISABLE position. The ControlFile cards can now be pulled.

When powering up the ControlFile, first enable the NV Memory card and then enable the primary and secondary Coordinator Processor cards.

Bubble NV Memory

The Bubble NV Memory uses Magnetic Bubble Memory (MBM) modules for data storage. Figure 4.2.22 shows the function diagram for a Bubble Nonvolatile Memory card.

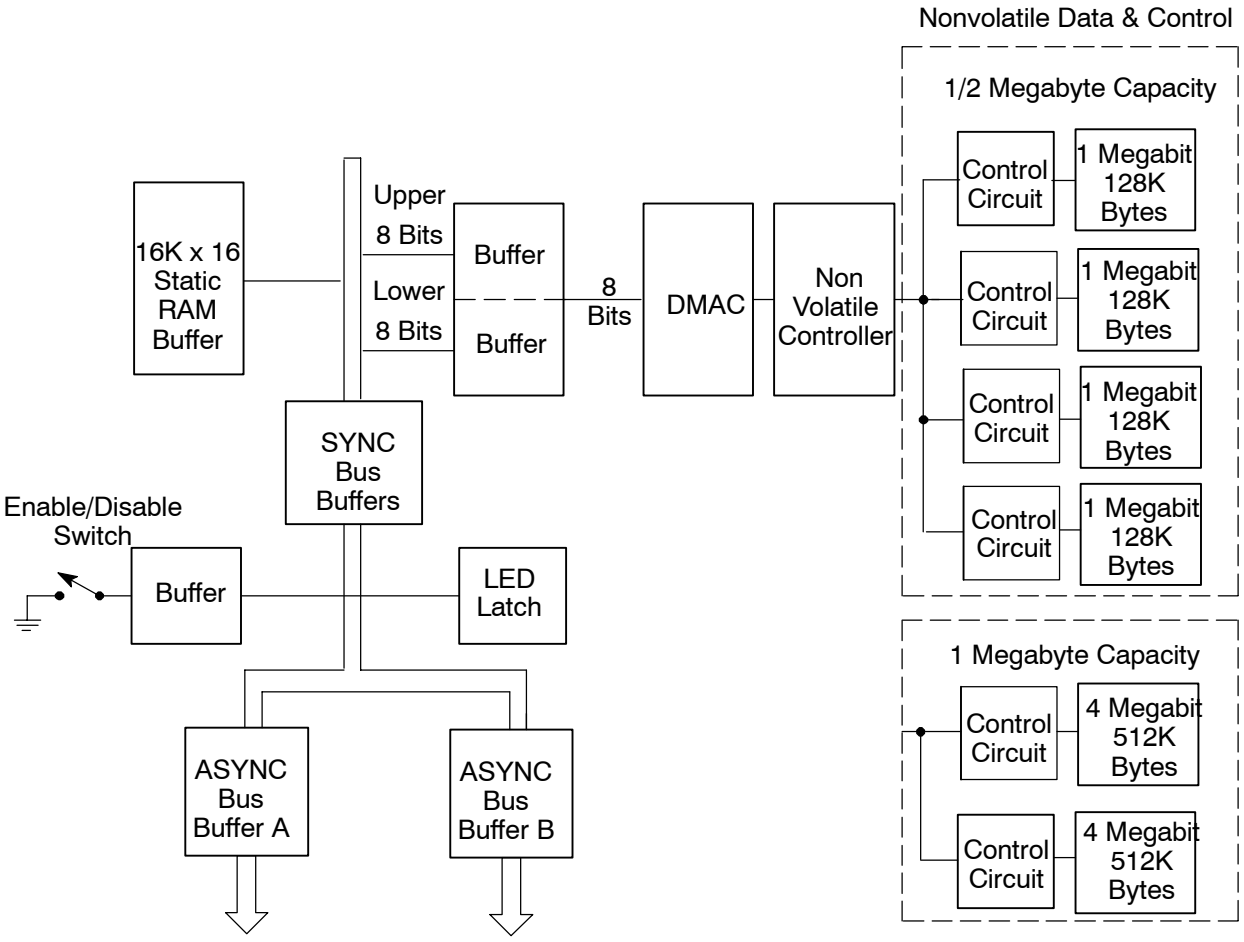


Figure 4.2.22. Bubble NV Memory Functional Diagram

The card is fused for +5 volts and +12 volts. The +12 volts is used for the magnetic bubble memory and control circuitry. Bus A arbitration circuit on the Bubble Nonvolatile Memory card determines which redundant motherboard port is accessing the card. The proper buffers are then enabled to transfer asynchronous data on the card.

A LED latch is driven by the bus through a software driven latch to light the green, red, or yellow status LEDs. There is also a read buffer on the card that determines the state of the ENABLE/DISABLE toggle switch.

The data bus operating off the motherboard asynchronous bus is then buffered to a synchronous bus for data transfer to those devices that are used to transfer the data to and from the nonvolatile memory. There are four RAM chips used for buffering data to and from the nonvolatile memory. The buffer RAM size is 16K x 16. The direct memory access controller (DMAC) and Bubble Memory Controller circuitry are designed for 8 bit words so that a set of buffers multiplexes the 16-bit words into two successive 8 bit words for transfer to the DMAC. The DMAC transfers data between the Bubble Memory Controller and RAM. The bubble memory controller changes the parallel data to serial data and provides the needed timing for operation of the bubble memory support circuitry. The serial data is then transferred to the selected magnetic bubble memory (MBM) modules for storage.

Each MBM module contains 5 support chips for the MBM. These chips format data, drive currents for the X and Y coils that move the magnetic bubbles within the MBM, and move the bubbles to storage. For the read cycle, the circuitry detects the bubbles, and formats and transfers the data back to the nonvolatile controller memory for serial to parallel data conversion.

The ControlFile motherboard has two slots for Nonvolatile Memory cards. These are not intended for redundancy but are useful during troubleshooting and recovery from a nonvolatile memory fault.

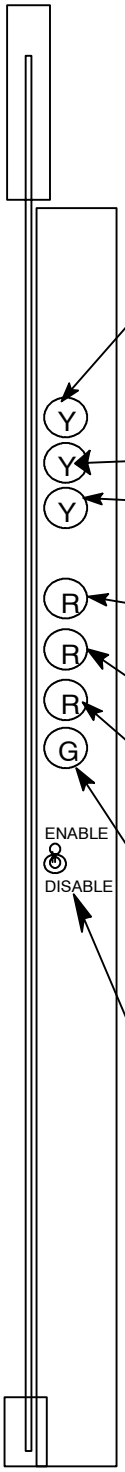
The MBM modules also contain error detection and correction (EDAC) circuitry for all data stored in the MBM. This EDAC circuitry is in the Formatter/Sense Amplifier (FSA). The error detection code used by the FSA is a 14 bit Fire code that is appended to each 256-bit block of data. The code is capable of correcting all single error bursts up to and including 5 bits in length.

It takes four times as much current to write a bubble as it does to copy a bubble. Each MBM has a seed bubble that is used to copy from. Any time an address is to be written to it is copied from the seed bubble. If this seed bubble is corrupted through a card fault or an improper insertion or removal procedure, the Bubble Nonvolatile Memory must be returned. Contact your local FRSI service center for more information.

Current bubble technology cannot produce perfect bubble matrices. To map around the faulty areas of the bubble the manufacturer has a boot program that identifies the bad areas of of each bubble in hexadecimal code. This information is stored in several locations in the MBM. If these locations should become corrupted, the Bubble Nonvolatile Memory card must be returned to the factory to be restored.

Bubble NV Memory: LEDs and Test Points

Figure 4.2.23 shows the LEDs, Enable/Disable Switch, and test points for the Bubble Nonvolatile Memory cards.



LEDS

PROGRAM ACCESS (DS8)	The Coordinator Processor is accessing the main operating programs of a Controller Processor or itself. The card is reading from Nonvolatile Memory to download data to a card, or is writing to the memory card from the disk drive.
WRITE (DS7)	The Nonvolatile Memory Card is being written to by the Coordinator Processor.
READ (DS6)	The Nonvolatile Memory Card is being read by the Coordinator Processor.
12 V FUSE BLOWN (DS4)	Replace Fuse F2 (Supplies 12 VDC to the card).
5 V FUSE BLOWN (DS3)	Replace Fuse F1 (Supplies 5 VDC to the card).
CARD FAULT (DS2)	A fault is detected on the Nonvolatile Memory or the Enable/Disable Switch is DISABLED. If the switch is ENABLED and this LED is ON, replace the card.
CARD ENABLED (DS1)	The Enable/Disable Switch is ENABLED and no hardware faults are detected on the NV Memory.

Enable/Disable Switch

The Enable/Disable Switch is read by the Coordinator Processor during operation. The result is that it knows when it can or cannot access the Nonvolatile Memory. Nonvolatile memory functions resume when the switch is enabled and the card has successfully passed power-up diagnostic tests.

Test Points at Top of Card (Not on 1984-1224-000X)

Yellow	+5 V (± 0.1 V)
Red	+12 V (± 0.1 V)
Brown	Ground Return

Figure 4.2.23. Bubble NV Memory LEDs and Test Points

Bubble NV Memory Jumpers

Bubble Nonvolatile Memory jumpers are only for factory use and should not be changed. Changing the jumpers could cause the bubbles to become corrupted.

Bubble NV Memory Fuses

Figure 4.2.24 shows fuse locations. Table 4.2.27 gives fuse values for the Bubble NV Memory card.

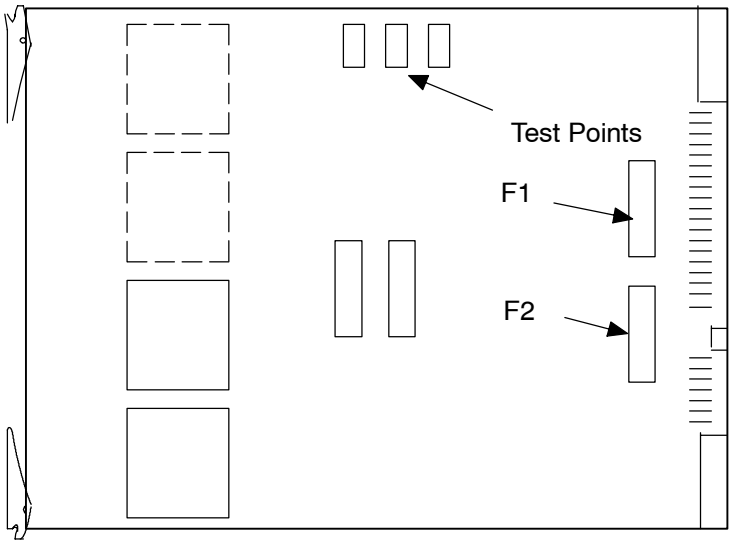


Figure 4.2.24. Bubble NV Memory Fuse Locations

Table 4.2.27. Bubble NV Memory Fuses

Card	Fuse	FRSI Part No.	Bussman Part No.	Littelfuse Part No.	Characteristics
1984-1598-0001	F1	G09140-0060	MTH 4	312004	4 A 250 V Regular
	F2	G09140-0041	MTH 5	312005	5 A 250 V Regular
1984-1483-000x	F1	G09140-0060	MTH 4	312004	4 A 250 V Regular
	F2	G09140-0030	AGC 2	312002	2 A 250 V Quick Acting
1984-1224-000x	F1	G09140-0038	MDL 4	313004	4 A 250 V Slow Blow
	F2	G09140-0030	AGC 2	312002	2 A 250 V Quick Acting

Section 3:
Controller Processors

Controller Processors include:

- MultiPurpose (MPC)
- MultiLoop (MLC)
- Single-Strategy (SSC)
- Contact (CC)
- Multiplexer (MUX)
- PLC Interface (PLC).

CAUTION

Disable the NV Memory and then the Coordinator Processor cards before removing any card (other than a PeerWay Buffer card) from the ControlFile. Failure to do so may result in a corrupted data transfer.

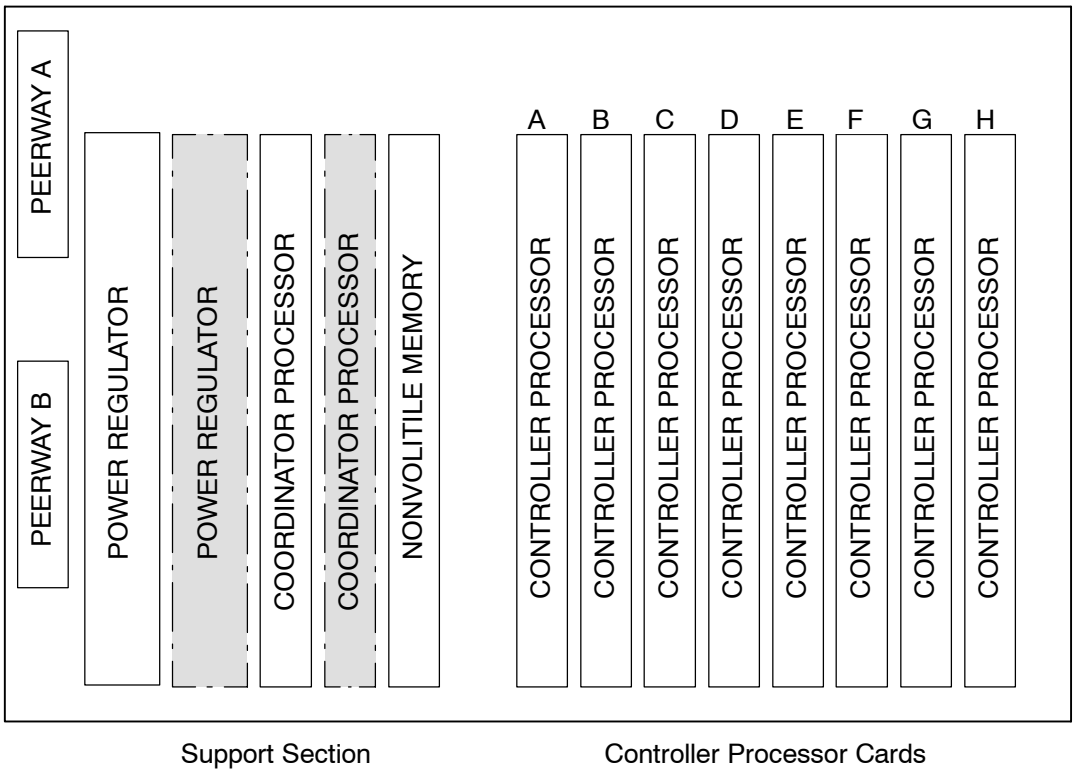


Figure 4.3.1. ControlFile Card Cage (Front)

MPC (MultiPurpose Controller Processor)

The MultiPurpose Controller (MPC) Processor card replaces the Contact Controller Processor (CCP), Programmable Logic Controller (PLC), Controller Processor, and Multiplexer (MUX) Controller Processors. The current versions of the MPC follow:

- MultiPurpose Controller Processor 5,
  (MPC5) 10P57520007
  Labeled “MPC5” on the printed wiring assembly (PWA).
- MultiPurpose Controller Processor II,
  (MPC II) 10P50400006
  1984-4068-000x
  Labeled “MULTIPURPOSE CONTROLLER II” on the PWA.
- MultiPurpose Controller Processor
  (MPC or MPC I) 1984-2500-000x
  Labeled “SERIAL PROCESSOR” on the PWA.

The MPC5 has a 68020, 256-byte instruction cache, 24 MHz, 32-bit databus while the MPC II has a 68000, no cache, 16 MHz, 16-bit databus. The MPC5 also has hardware support for higher performance I/O communications including PLC connectivity.

The MPC II performs all of the functions of the original MPC but has a faster clock and more memory.

The MPC II Processor can be jumpered to accept different software images so that it can replace a Contact, a Multiplexer (MUX), or a PLC Controller Processor. It cannot replace a MultiLoop or a Single-Strategy Controller Processor. The MPC II can be configured with 1024 I/O points. They can be a mixture of analog and discrete points.

An MPC can communicate with a variety of I/O or other interface devices via eight digital RS-422 communications lines. The communication rates are listed in Table 4.3.1. The Baud rate is set by a jumper for all MPCs except the MPC5 where it is set by software.

Table 4.3.1. MPC Communication Rates

Interface Device	MPC, MPC I, or MPC II	MPC5
RS3 I/O	10.4K Baud	10.4K Baud
MUX	9600 Baud	9600 Baud
PLC	300-9600 Baud	300-19.2K Baud

The MPC supports the Controller images and associated Card Cages or FlexTerms listed in Table 4.3.2.

The MPC cannot fully support these images or associated FlexTerms:

- Single Strategy
- MultiLoop
- AutoTuning MultiLoop Controller

Table 4.3.2. Controller Images and Associated Card Cages or FlexTerms

	MPC or MPC I	MPC II	MPC5
Analog I/O (Serial I/O, MAIO)	✓	✓	✓
Contact	✓	✓	
Multiplexer	✓	✓	✓
Programmable Logic Controller (PLC)	✓	✓	✓
Rosemount Basic Language (RBLC)	✓	✓	✓
Smart	✓	✓	✓
Pulse	✓	✓	✓
RTD/Thermocouple	✓	✓	
Discrete		✓	✓

Table 4.3.3 shows parts replacement data. A change of MPC may require a software change.

Table 4.3.3. MPC Parts Replacement

Name	Part No.	Replaces	Characteristics
MPC5	10P57520007	- -	
MPC II	10P50400006	1984-4068-000x 1984-2500-000x 1984-1494-000x 1984-1445-000x 1984-1374-000x	Replaces MPC II, MPC, CC, PLC, and MUX Controller Processors. (Requires jumper setting)
MPC II	1984-4068-000x	1984-2500-000x 1984-1494-000x 1984-1445-000x 1984-1374-000x	Replaces MPC as well as CC, PLC, and MUX Controller Processors (Requires jumper setting)
MPC	1984-2500-000x	1984-1494-000x	Multiplexer (MUX) Controller Processor Programmable Logic Controller (PLC) Controller Processor
		1984-1445-000x	Contact Controller (CC) Controller Processor
		1984-1374-000x	Contact Controller (CC) Controller Processor

The MultiPurpose Controller can be installed in any slot A through H. When a MultiPurpose Controller is used in a redundant pair configuration, only slots AB, CD, EF, and GH can be used as redundant pairs. MultiPurpose Controllers can be used in redundant pairs if the image being run supports redundancy and the controllers are identical.

Flat redundancy cables have two connectors at one end. These two connectors connect to the corresponding controller connectors on the ControlFile Motherboard. A redundant flat cable cannot be used on a nonredundant controller. Should a redundant flat cable be used on a nonredundant controller, the controller assumes it is redundant and clears the configuration for the adjacent slot. (This is true of MPC Controller Processors that are running the CC image.)

Redundancy on Serial I/O card cages (both Analog and Contact) is handled differently. The redundant controllers are connected to the I/O cage by separate cables and redundancy jumpering is done at the I/O card cage(s).

If the Controller Processor loses RS-485 communications with the Field Interface Card, the redundant controller will take over. Note that this will happen any time a Field Interface Card (FIC) is removed from a FlexTerm or I/O Card Cage. Hardware alarm code #19 will be generated when this occurs. Hardware alarms from the controllers are prioritized. If both controllers have active alarms, the controller with the lowest priority alarm will operate as primary.

There are two rows of connectors across the backplane of the ControlFile motherboard, an upper and a lower. Only the upper row is used by the MultiPurpose Controller. Each Controller slot has a corresponding connector on the top row of connectors. This connector allows connection to the serial I/O Analog Card Cages and/or FlexTerms.

MPC5 Function

Figure 4.3.2 shows a functional diagram of the MultiPurpose Controller Processor 5 (MPC5).

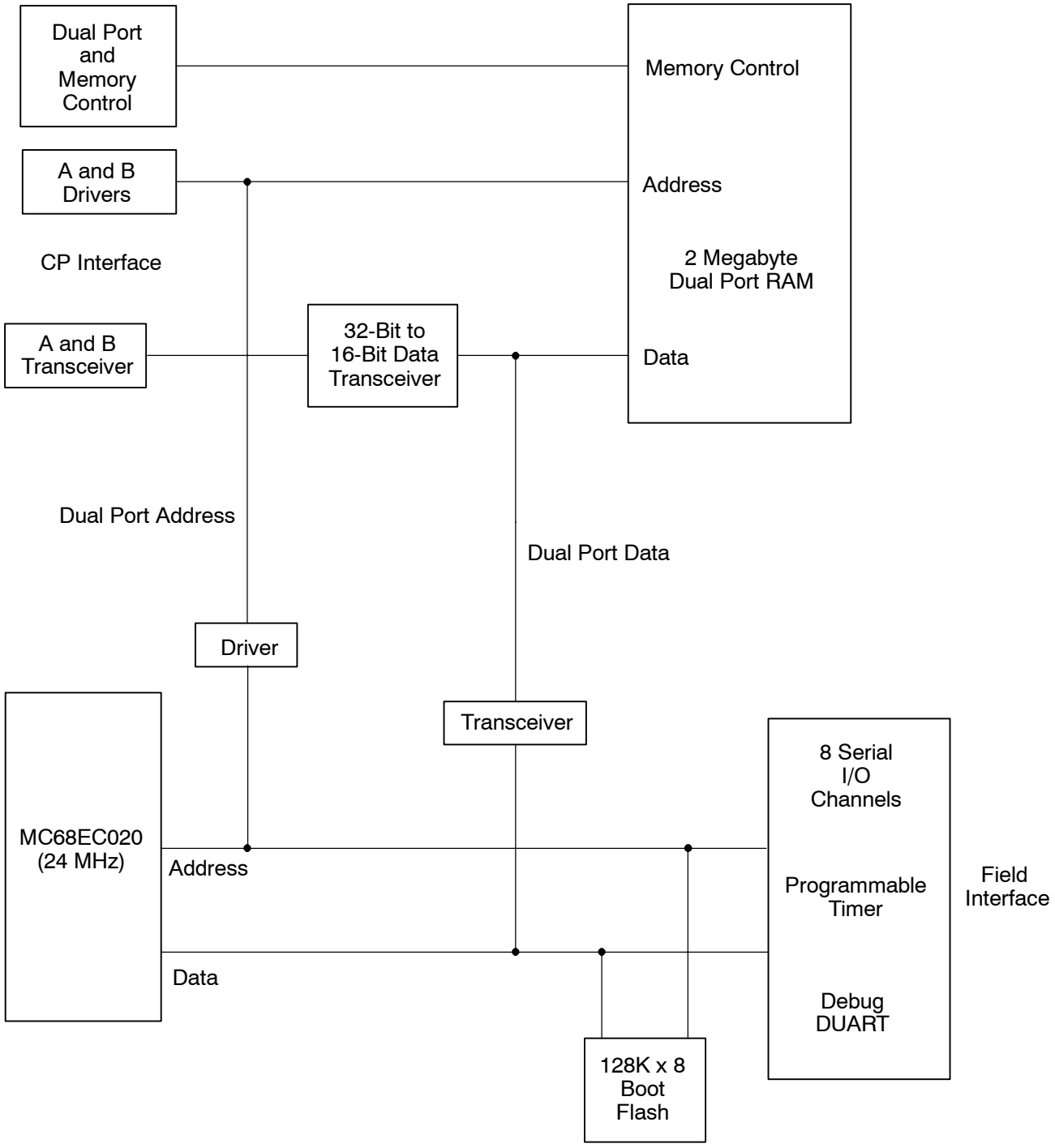


Figure 4.3.2. MPC5 Functional Diagram

The data from two redundant Coordinator Processors on separate redundant buses are selected and buffered on the card to isolate the two in case of a failure of either bus. These two buffers come together at the dual port bus that has 2 Megabytes of RAM. The remainder of the card is separated from the dual port bus. The Coordinator Processor must have unrestricted access to the RAM on the controller in order to permit it to download the operation and configuration data. After the data is downloaded, the Controller Processor limits the memory access of the Coordinator Processor to the area containing the dynamic and configuration data.

The MC68HC020 microprocessor controls all the functions on the card and is monitored by the watchdog timer. If it is not reset periodically by the microprocessor, the watchdog timer toggles the reset line to the microprocessor, which forces a restart.

All the LEDs are controlled by the LED latch, which includes the Card Enable (green), Card Fault (red), and three yellow status LEDs.

The card ENABLE/DISABLE switch is read through a buffer to indicate to the processor when it should disable processing.

During initial power up of the card, the microprocessor does diagnostics from data stored in programs loaded in the 128K x 8 FLASH. After the MPC5 has successfully completed the diagnostic tests, it informs the Coordinator Processor which IMAGE it is jumpered for and requests the operating program. The Controller, now executing its own internal program, will then request the Coordinator Processor to download any configuration data stored in the Nonvolatile Memory.

Communication with up to eight Field Interface Cards is handled by the eight serial communication converters that transfer the parallel data from the card data bus to serial NRZ data. Each communication converter is capable of supporting one Field Interface Card communication line. The serial data from the communication chip at transistor to transistor logic (TTL) level is then converted to RS-422 and sent to the Field Interface Cards through the cables. Receive data is in a similar format.

MPCII Function

Figure 4.3.3 shows a functional diagram of the MultiPurpose Controller Processor II (MPCII).

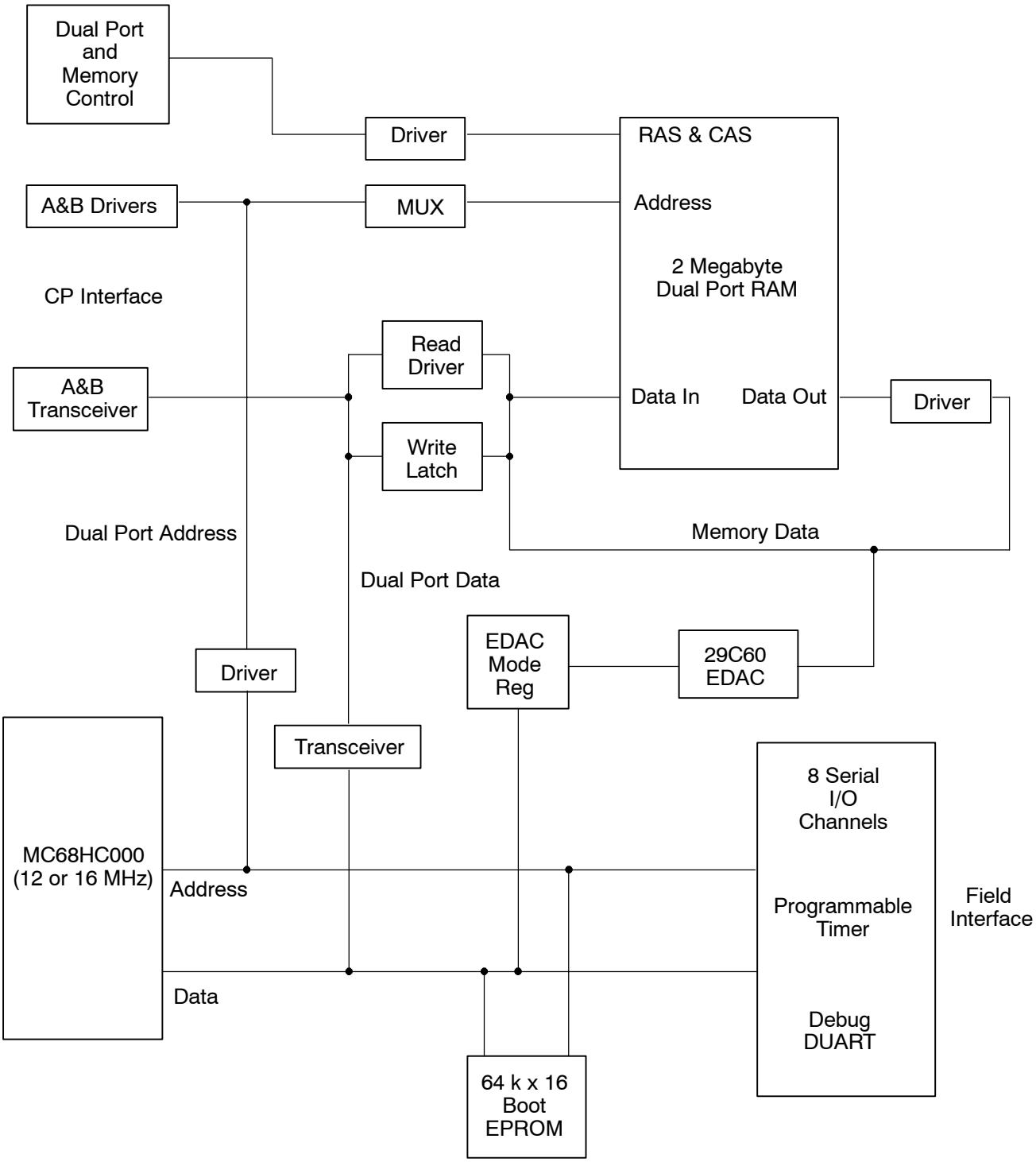


Figure 4.3.3. MPCII Functional Diagram

The MPC II can operate either as an MPC I or as an MPC II. The data from two redundant Coordinator Processors on separate redundant buses are selected and buffered on the card to isolate the two in case of a failure of either bus. These two buffers come together at the dual port bus that also has the 2 Megabyte dynamic RAM with EDAC. The remainder of the card is separated from the dual port bus because the Coordinator Processor must have restricted access to the dynamic RAM on the controller in order to permit it to download the operation and configuration data. After the data is downloaded, the Controller Processor limits the memory access of the Coordinator Processor to the area containing the dynamic and configuration data.

The MPC II card contains dynamic RAM and EDAC control circuitry. The dynamic memory controller does the required address multiplexing for the RAM chips and handles the refresh cycle. The dynamic RAM chips have separate pins for the read and write function. A separate read/write select provides separation and data bus buffering. The EDAC controller decodes the check bits that are stored along with the data bits. A 16-bit word is used in conjunction with the 16-bit microprocessor. Six additional bits are used to store a pattern that can be decoded to indicate the exact bit pattern in the data word. If any single bit is not as indicated by the EDAC check bits, the EDAC Controller automatically corrects for the error and rewrites the data into the RAM location correctly. If any multiple bit errors are found, the EDAC will trigger a bus error to indicate problems to the operators station. RAM capacity is 2 Megabytes with 8 bits per byte and 2 bytes per word. An additional six bits associated with each word are the check bits.

The clock oscillator is divided down to provide all the timing requirements of the microprocessor and the remainder of the support devices on the card. The system clock rate is selected by jumper as either 12 MHz (MPC I operation) or 16 MHz (MPC II operation). The MC68HC000 microprocessor controls all the functions on the card and is monitored by the watchdog timer. If it is not reset periodically by the microprocessor, the watchdog timer toggles the reset line to the microprocessor which forces a restart.

All the LEDs are controlled by the LED latch, which includes the Card Enable (green), Card Fault (red), and three yellow status LEDs.

The card ENABLE/DISABLE switch is read through a buffer to indicate to the processor when it should disable processing.

During initial power up of the card, the microprocessor does diagnostics from data stored in programs loaded in the 64K x 16 EPROM. After the MultiPurpose Controller II has successfully completed the diagnostic tests, it informs the Coordinator Processor which IMAGE it is jumpered for and requests the operating program. The Controller, now executing its own internal program, will then request the Coordinator Processor to download any configuration data stored in the Nonvolatile Memory.

Communication with up to eight Field Interface Card communication lines is handled by the four dual port serial communication converters that transfer the parallel data from the card data bus to serial NRZ data. Each communication converter is capable of supporting two Field Interface Card communication lines. The serial data from the communication chip at TTL level is then converted to RS-422 and sent to the Field Interface Cards through the cables. Receive data is in a similar format.

MPCI Function

Figure 4.3.4 shows a functional diagram for the MultiPurpose Controller Processor (MPCI).

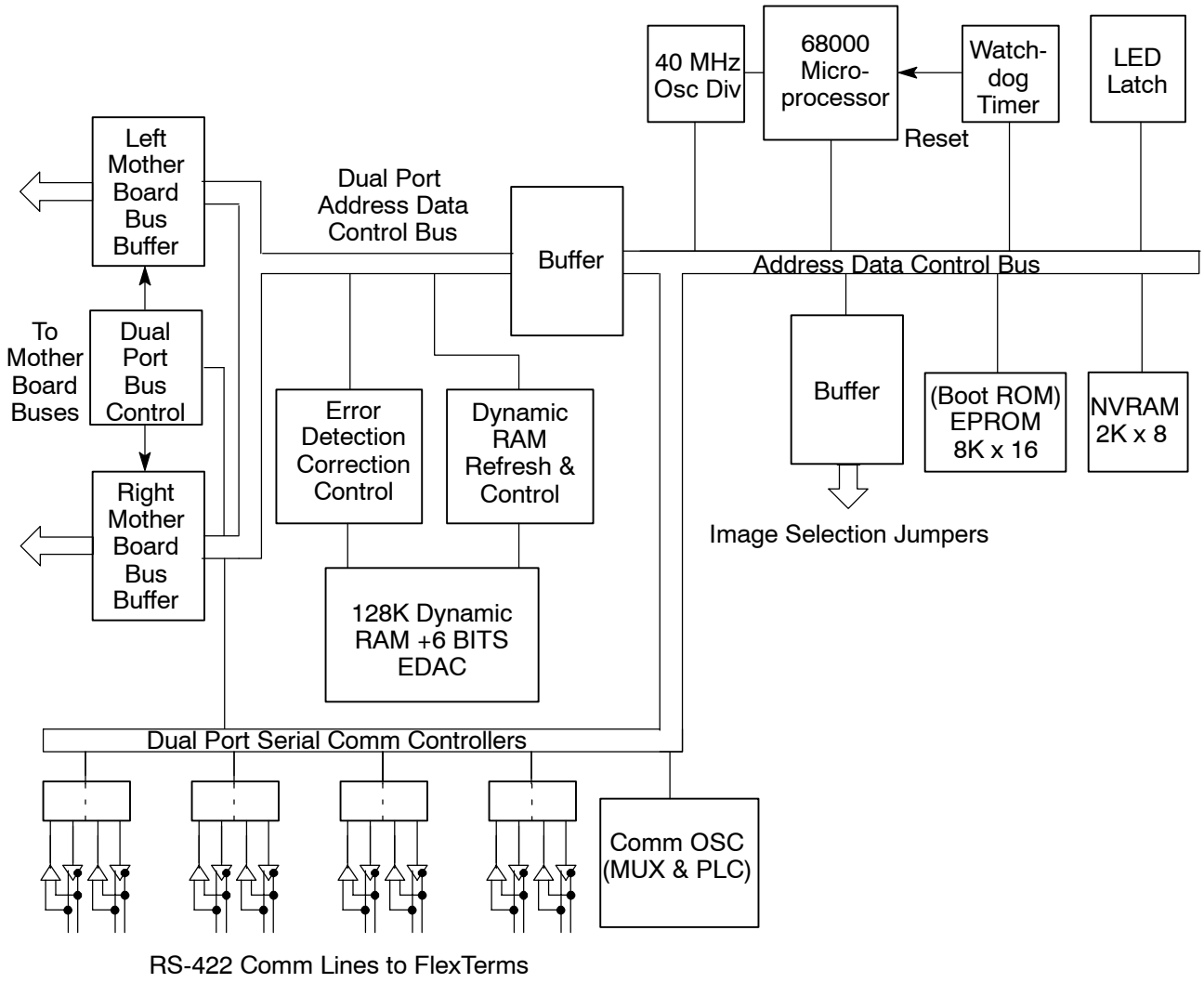


Figure 4.3.4. MPCI Functional Diagram

The data from two Coordinator Processors on separate redundant buses is selected and buffered on the card to isolate the two in case of a failure of either bus. These two buffers come together at the dual port bus that also has the 64K x 22 dynamic RAM with Error Detection and Correction (EDAC). The remainder of the card is separated from the dual port bus because the Coordinator Processor card must have access to the dynamic RAM on the controller to permit it to download the operation and configuration data. After the data is downloaded, the Controller Processor limits the memory access of the Coordinator Processor to the area containing the dynamic and configuration data.

The MPC card contains dynamic RAM and EDAC control circuitry. The dynamic memory controller does the required address multiplexing for the RAM chips and handles the refresh cycle. The dynamic RAM chips have separate pins for the read and write function. A separate read/write select provides separation and data bus buffering. The EDAC controller decodes the check bits that are stored along with the data bits. A 16-bit word is used in conjunction with the 16-bit microprocessor. Six additional bits are used to store a pattern that can be decoded to indicate the exact bit pattern in the data word. If any single bit is not as indicated by the EDAC check bits, the EDAC Controller automatically corrects for the error and rewrites the data into the RAM location correctly. If any multiple bit errors are found, the EDAC will trigger a bus error to indicate problems to the operator's station. Each dynamic RAM chip is arranged in a 64K x 1 bit pattern. RAM capacity is 128K bytes, or 64K words, with 8 bits per byte and 2 bytes per word. There are six additional bits with each word as check bits.

The 40 MHz clock oscillator is divided down to provide the timing requirements of the microprocessor and the remainder of the support devices on the card. The 68000 series microprocessor controls all the functions on the card and is monitored by the watchdog timer. If it is not reset periodically by the microprocessor, the watchdog timer toggles the reset line to the microprocessor which forces a restart.

All the LEDs are controlled by the software driven LED latch, which includes the Card Enable (green), Card Fault (red), and three yellow status LEDs.

The card ENABLE/DISABLE switch is read through a buffer to indicate to the processor when it should disable processing.

During initial power up of the card, the microprocessor does diagnostics from data stored in programs loaded in the 8K x 16 EPROM. After the MultiPurpose Controller has successfully completed the diagnostic tests, it informs the Coordinator Processor which IMAGE it is jumpered for and requests the operating program. The controller, now executing its own internal program, will then request the Coordinator Processor to download any configuration data stored in the Nonvolatile Memory.

Communication with up to eight Field Interface Cards is handled by the four dual port serial communication converters that transfer the parallel data from the card data bus to serial NRZ data. Each communication converter is capable of supporting two Field Interface Card communication lines. The serial data from the communication chip at TTL level is then converted to RS-485 and sent to the Field Interface Cards through the cables. Receive data is in a similar format.

MPC LEDs

The LEDs of all Controller Processor cards are essentially identical. See the LED description later in this section.

MPC5 Jumpers

MPC5 jumpers differ from those on the other Controller Processor cards. Figure 4.3.5 shows MPC5 jumper locations. Table 4.3.4 shows the MPC5 jumper label.

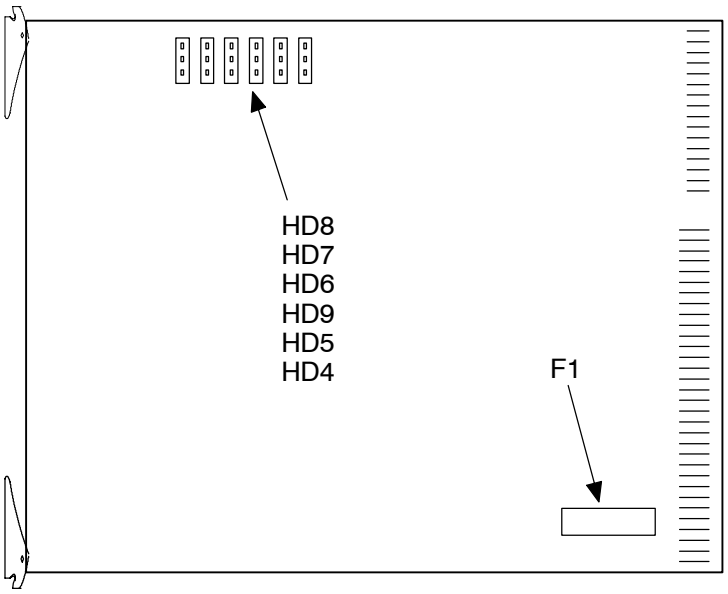


Figure 4.3.5. MPC5 Fuse and Jumper Locations

Table 4.3.4. MPC5 Jumper Label

10P57520007 MPC5 JUMPER SETTINGS			
PROCESSOR FUNCTIONALITY			
IMAGE SELECT	HD6	HD7	HD8
ADDITIONAL IMAGE #1	1-2	1-2	1-2
ADDITIONAL IMAGE #2	1-2	2-3	2-3
ADDITIONAL IMAGE #3	1-2	2-3	1-2
ADDITIONAL IMAGE #4	1-2	1-2	2-3
MPC5 IMAGE FUNCTIONALITY	**HD4**	**HD5**	**HD9**
MPC+	1-2	1-2	1-2
PLC+	1-2	1-2	2-3
MUX+	1-2	2-3	1-2

Image Select (HD6-HD8): These jumpers select one of the images shown on the label under “Processor Type”. Four images are listed for MPC5 functionality. The actual image loaded depends on the system configuration.

CAUTION

No mixing of MPCIIs with MPC5s in a ControlFile is allowed.

The ControlFile Status screen has a three-digit Jumper Code field that shows the placement of all jumpers. This code is shown when using an MPC5 image. Jumper position 1-2 is “1”, and 2-3 is “0”. The first digit is always “1”. The second digit reports the positions of HD6, HD7, and HD8 as an octal number (0-7), with HD6 as the high order bit. The third digit reports on HD4, HD5, and HD9.

NOTE: With the MPC5, the I/O communication baud rate is set by software instead of by a hardware jumper (as done by the MPCII and MPC). The baud rate is set automatically when either the PLC+ or MUX+ image is selected.

Table 4.3.5. ControlFile Status Screen Jumper Code (MPC5)

Jumper Code	Image Selection	MPC5 Image Functionality
145	Additional Image #2	MUX5
146	Additional Image #2	PLC5
147	Additional Image #2	MPC5
155	Additional Image #3	MUX5
156	Additional Image #3	PLC5
157	Additional Image #3	MPC5
165	Additional Image #4	MUX5
166	Additional Image #4	PLC5
167	Additional Image #4	MPC5
175	Additional Image #1	MUX5
176	Additional Image #1	PLC5
177	Additional Image #1	MPC5

MPCII Jumpers

MPCII jumpers differ from those on the other Controller Processor cards. Figure 4.3.6 shows MPCII jumper locations. Table 4.3.6 shows the MPCII jumper label.

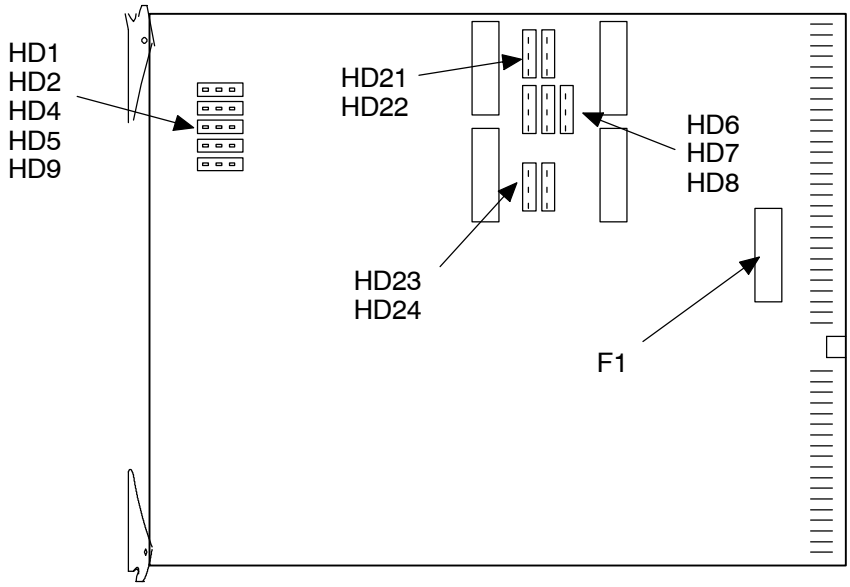


Figure 4.3.6. MPCII Fuse and Jumper Locations

Table 4.3.6. MPC II Jumper Label

01984-4086-0006
CONTROL PROCESSOR II JUMPER SETTINGS

COMMUNICATION RATE	HD21	HD22	HD23	HD24
FISHER-ROSEMOUNT 10.4K BAUD	2-3	2-3	2-3	2-3
INDUSTRY STANDARD	1-2	1-2	1-2	1-2

PROCESSOR FUNCTIONALITY

MPC	HD2	MPC II	HD2	
	2-3		1-2	

PROCESSOR TYPE				PROCESSOR TYPE			
IMAGE SELECT	HD6	HD7	HD8	IMAGE SELECT	HD6	HD7	HD8
CONTACT	2-3	2-3	1-2	ADDITIONAL IMAGE #1	1-2	1-2	1-2
MULTIPLEXER	2-3	1-2	1-2	ADDITIONAL IMAGE #2	1-2	2-3	2-3
ADDITIONAL IMAGE #1	1-2	1-2	1-2	ADDITIONAL IMAGE #3	1-2	2-3	1-2
ADDITIONAL IMAGE #2	1-2	2-3	2-3	ADDITIONAL IMAGE #4	1-2	1-2	2-3
ADDITIONAL IMAGE #3	1-2	2-3	1-2	**MPC2+ IMAGE FUNCTIONALITY**	**HD4**	**HD5**	**HD9**
ADDITIONAL IMAGE #4	1-2	1-2	2-3	MPC+	1-2	1-2	1-2
				PLC+	1-2	1-2	2-3
				MUX+	1-2	2-3	1-2

01984-2572-0002 REV C

Communication Rate (HD21-HD24): Select 10.4 K Baud speed for use with most FICs or the Industry Standard (9600 Baud) speed for special applications, specifically MUX and PLC.

Processor functionality (HD2): This jumper controls the clock speed of the on-board computer chip.

CAUTION

HD2 must be set to agree with the image being loaded. Setting it for MPC functionality with an MPCII image (or vice versa) may result in operating problems.

When MPC functionality is selected (HD2 set to 2-3), the clock runs at the MPCI card speed of 12 MHz.

When MPCII functionality is selected (HD2 set to 1-2), the clock runs at the MPCII card speed of 16 MHz.

Image Select (HD6-HD8): These jumpers select one of the images shown on the label under "Processor Type". Six images are listed for MPCI functionality and four for MPCII functionality. The actual image loaded depends on the system configuration.

CAUTION

Selecting an MPCI image with HD2 set for MPCII functionality (or the reverse) may result in operating problems.

MPC2+ Image Functionality (HD4, HD5, HD9): These jumpers are read by an MPCII image to select one of the three MPCII functions.

Normally a combination of Image Select and MPC2+ Image Functionality jumpers will be specified for MPCII operation.

The ControlFile Status screen has a three-digit Jumper Code field that shows the placement of all jumpers except the Communication Rate jumpers (HD21-HD24). This code is shown when using an MPCII image. Jumper position 1-2 is "1" and 2-3 is "0". The first digit reports the position of HD2. The second digit reports the positions of HD6, HD7, and HD8 as an octal number (0-7), with HD6 as the high order bit. The third digit reports on HD4, HD5, and HD9.

If HD2 is set incorrectly for an MPCII Image, the code will start with "0" and be in red. Table 4.3.5 translates the Jumper Code.

Table 4.3.7. ControlFile Status Screen Jumper Code (MPC2+)

Jumper Code	Processor Functionality	Image Selection	MPC2+ Image Functionality
0xx (Red)	MPC I	Jumper HD2 is set for MPC I functionality with an MPC II Image	
145	MPC II	Additional Image #2	MUX+
146	MPC II	Additional Image #2	PLC+
147	MPC II	Additional Image #2	MPC+
155	MPC II	Additional Image #3	MUX+
156	MPC II	Additional Image #3	PLC+
157	MPC II	Additional Image #3	MPC+
165	MPC II	Additional Image #4	MUX+
166	MPC II	Additional Image #4	PLC+
167	MPC II	Additional Image #4	MPC+
175	MPC II	Additional Image #1	MUX+
176	MPC II	Additional Image #1	PLC+
177	MPC II	Additional Image #1	MPC+

MPC I Jumpers

MPC I jumpers are essentially identical to the other CP cards. See the jumper description at the end of this section for MPC I jumpers.

MPC Fuses

Table 4.3.8 gives fuse data for the MPC, MPC II, and the MPC5. Fuse locations are shown in Figure 4.3.5 (MPC5), Figure 4.3.6 (MPC II),and Figure 4.3.7 (MPC I).

Table 4.3.8. MPC I, MPC II, and MPC5 Fuses

Card	Fuse	FRSI Part No.	Bussman Part No.	Littelfuse Part No.	Characteristics
MPC5 10P57520007	F1	G09140-0034	AGC 3	312003	3 A 250 V Regular
MPC II 10P50400006 1984-4068-000x	F1	G09140-0041	MTH 5	312005	5 A 250 V Regular
MPC I 1984-2500-000x	F4	G09140-0041	MTH 5	312005	5 A 250 V Regular

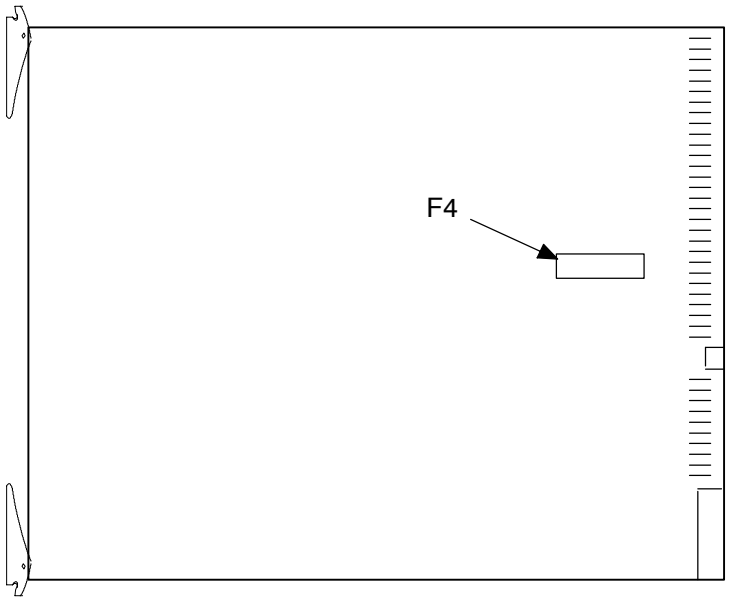


Figure 4.3.7. MPC I Fuse Location

MLC (MultiLoop Controller Processor)

There are two MultiLoop Controller Processor (MLC) versions:

- MLC (1984–1439–000x)
  Marked “MULTILOOP PROCESSOR” on the PWA
- MLC (1984–1249–000x)
  Marked “MULTISTRATEGY PROCESSOR” on the PWA

The MLC has eight RS-422 communication ports and 16 analog inputs.

One MultiLoop FlexTerm is connected to the Controller Processor through two cables. The upper cable (connected from the top connector of the ControlFile card cage to the upper connector of the FlexTerm) carries the communications lines and analog feedback for eight output Field Interface Cards (FIC). The lower cable carries the analog inputs for the eight input ICs.

Each output FIC requires one communication port and one analog input. Each input FIC requires one analog input. Any or all of the output FICs can be removed and input FICs can be put in their place to provide added flexibility in the FlexTerm. Output FICs cannot be placed in the lower eight dedicated input slots of the FlexTerm.

Redundancy: The MultiLoop Controller can be installed in any slot A through H. When a MultiLoop Controller is used as a redundant pair, only slots AB, CD, EF, and GH can be used as redundant pairs.

Flat and round cables are used for redundancy. Flat cables have two connectors at one end. These two connectors connect to the adjacent controller slots. For the round cable version, two short cables are connected from the two adjacent controller slots to a special connection board. The third connector on this board is used to connect to the FlexTerm. This connector board also has a jumper between pins 7 and 8 to indicate to the controller that it is redundant.

It is important to note that a redundant flat cable cannot be used on a nonredundant controller for the upper connectors. Should a redundant flat cable be used on a nonredundant controller, the controller assumes it is redundant and clears out the configuration for the adjacent slot, because a redundancy indication for one controller is assumed for both.

If the controller processor loses RS-422 communications with the FIC, the redundant controller will take over. Note that this will happen any time an FIC is removed from the FlexTerm. Also, if an Instrument High or Low alarm is generated on a redundant controller pair, the redundant controller will also take over, assuming that the A/D on the primary controller has failed. If the controller switchover was for one of these reasons, the alarm indication on the ControlFile Status Screen can be cleared by rebooting the redundant controller.

Instrument HIGH and LOW alarms must be configured to ensure that the redundant controllers will switchover in case of a controller A/D fault. Hardware alarms from the controllers are prioritized. If both controllers have active alarms, the controller with the lowest priority alarm will take over as primary controller.

MLC Function

This circuit description refers only to the MultiLoop Controller and Single Strategy cards as shown in Figure 4.3.8.

Nonvolatile RAM: The MultiLoop Processor and Single-Strategy cards contain a Nonvolatile RAM (2K X 8) that can be altered electrically and does not lose its data when power is lost. The NVRAM is used to store calibration data for the analog inputs and outputs. There are no calibration pots on the FICs. To calibrate the FICs, current is monitored at the FIC and the proper value is entered into the operators station. This value is compared with the current output or input and the calibration value is corrected. Each time the controller writes a new output or reads a new input, the controller automatically adjusts the value stored in the NVRAM. See Chapter 8, “Calibration”, for details.

Because Multiplexer calibration constants are stored in an area of nonvolatile memory, contents should be reentered when the Nonvolatile Memory is replaced or changed. Calibration data for serial I/O points is stored in memory on the FICs.

Analog Input: The MultiLoop Processor and Single-Strategy cards have an analog input section that performs the analog to digital (A/D) conversion. The analog input section is used for two purposes. The first is to bring in the 4–20 mA input and drop it across a precision 250 ohm resistor on the Input FIC. This voltage is then fed to the analog input of the MLC Card and digitized through the A/D section. The second is on a 4–20 mA output loop, which is dropped across a 125 ohm resistor on the output FIC. This voltage is fed to the MLC Card to be digitized and used as a verification that the output current is of the correct value. The MLC Card can correct the digital value communicated to the output FIC for up to a 5% error and will generate an alarm on any error greater. This can also indicate that no field current is going through the circuit (open loop).

A precision zener is multiplexed into each A/D converter to check conversion accuracy.

A programmable timer module (PTM) is used to measure the time periods required for the A/D conversion. A clock for these time periods is derived from the clock/divider circuit. A set of synchronous buffers is used to isolate the data bus for the PTM. The PTM is a synchronous device from the 68000 system asynchronous bus.

Hybrids: There are four different hybrids used to process the analog input signals into the MLC Card.

The first hybrid has input voltages fed in for differential buffering and filtering. The filtering is in two stages. The first filter only allows voltage ramp changes of less than an 18 Hz rate change through a single pole op-amp filter. This output is then fed into a two pole op-amp filter for further limiting to a 3.75 Hz rate change. A circuit gain of 1 to 1 is used and close tolerance resistors (laser trimmed) are specified to avoid losing accuracy in the system. This hybrid contains two identical isolated circuits that use +12 V and –12 V for power.

The second hybrid is a multiplexer circuit that selects one of four inputs or the self check reference voltage to be routed to the A/D converter. Each hybrid contains two identical circuits to route signals to two A/D converters. Both use common control lines for switching. The signal switching is done by FET ICs that have a high off resistance and low on resistance.

The third hybrid is the A/D converter integrator. The circuit makes up a dual slope integrator A/D that has a sample rate of 16 samples per second. Control signals from the Programmable Timer Module (PTM) turn on the input voltage to ramp up the charge on a capacitor to discharge to zero volts using the precision 5.5 V reference into the minus input of the op-amp. This type of A/D converter is unaffected by resistor and capacitor tolerances and value changes because of temperature variation.

The fourth hybrid is the precision 5.5 volt reference generated by a special temperature-compensated IC with buffered output.

Power Up Diagnostics: During initial power up of the card, the microprocessor does its primitive diagnostics from data stored in programs loaded in the EPROM. Once the Coordinator Processor has downloaded the operating program from the bubble memory, the operating system stored in RAM takes over.

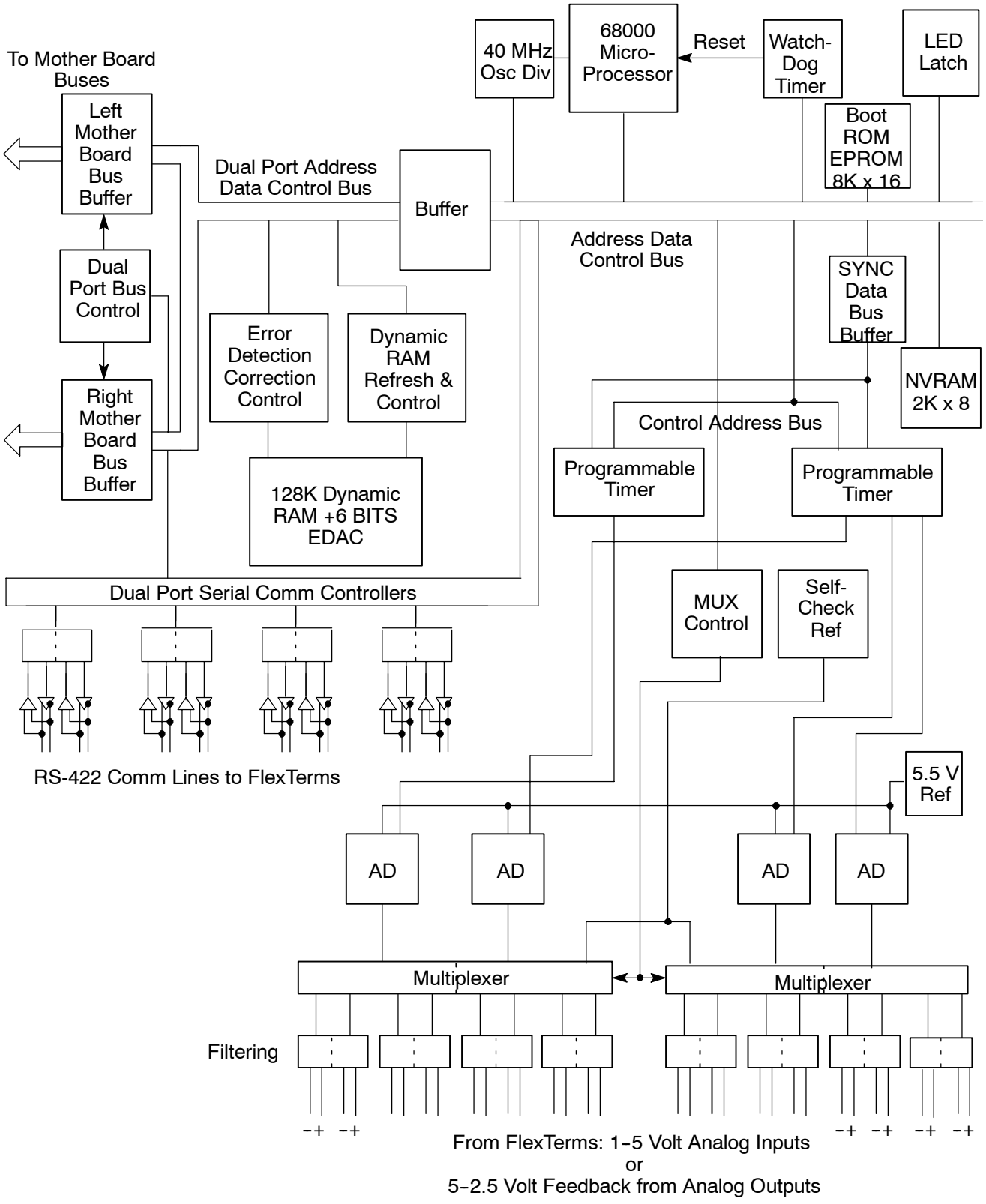


Figure 4.3.8. MultiLoop Controller Processor Functional Diagram

MLC LEDs

The LEDs of all Controller Processor cards are essentially identical. See the LED description later in this section.

MLC Jumpers

The jumpers of all Controller Processor cards (except MPC II) are essentially identical. See the jumper description later in this section.

MLC Fuses

Figure 4.3.9 shows the MLC fuse locations. Table 4.3.9 gives fuse data.

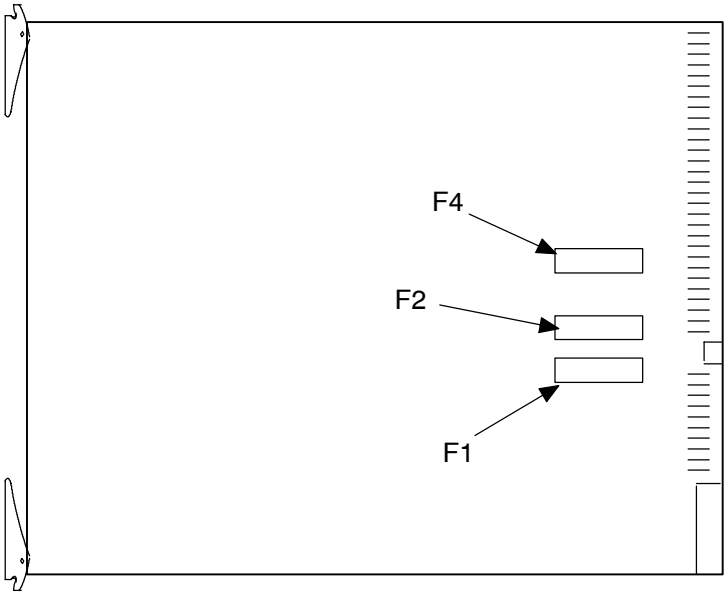


Figure 4.3.9. MLC Fuse Locations

Table 4.3.9. MLC Fuses

Fuse	FRSI Part No.	Bussman Part No.	Littelfuse Part No.	Characteristics
F1 F2	G09140-0016	AGC 1/2	312.500	1/2 A 250 V Quick Acting
F4	G09140-0041	MTH 5	312005	5 A 250V Regular

SSC (Single Strategy Controller Processor)

The Single-Strategy Controller Processor (SSC) is similar in function to the MultiLoop Controller discussed earlier in this section. See the MLC functional description for a summary of SSC processing.

There are two models of SSC (1984–1442–000x and 1984–1371–000x). They are both marked “SINGLE STRATEGY PROCESSOR” on the PWA.

One Single-Strategy FlexTerm is connected to the SSC through one cable. One Single-Strategy FlexTerm can contain FICs for two SSCs.

The Single-Strategy Processor has three RS-422 communication ports and 6 analog inputs. Each Output FIC requires one communication port and one analog input. Each Input FIC requires one analog input. Each Contact FIC requires one communication port.

The SSC can control four 4–20 mA inputs, two outputs, and six contact points. Three RS-422 communications ports are provided: two for the output FICs; and one for the contact FIC. Six analog inputs are also provided; two for the Output FICs, and four for the input FICs. Any or both of the output FICs can be removed and input FICs can be placed in the slots to provide added flexibility in the FlexTerm. Output FICs cannot be placed in the dedicated input slots.

Communication to the two Output FICs and the Contact FIC is handled by the three dual port serial communication converters that transfer the parallel data from the data bus to serial RS-422 data.

Analog Input: The Single-Strategy Processors have an analog input section that performs the analog to digital (A/D) conversion. The analog input section is used for two purposes. The first is to bring in the 4–20 mA input and drop it across a precision 250 ohm resistor on the Input FIC. This voltage is then fed to the analog input of the controller card and digitized through the A/D section. The second is on a 4–20 mA output loop. The loop current is dropped across a 125 ohm resistor on the Analog Output Field Interface card. This voltage is fed to the controller card to be digitized and used as a verification that the output current is of the correct value. The controller can correct the digital value communicated to the Analog Output FIC for up to a 5% error and will alarm on any error greater. This can also indicate that no field current is going through the circuit (open loop).

Calibration: To calibrate the FICs, current is monitored at the FIC with an accurate device and the proper current is entered into the operator’s station. This current is compared with the current output or input and the calibration value is corrected. Each time the controller writes a new output or reads a new input, the controller automatically adjusts with the value stored in the NVRAM.

Redundancy: The Single-Strategy Controller can be installed in any slot A through H. When a Single-Strategy Controller is used as a redundant pair, only slots AB, CD, EF, and GH can be used as redundant pairs. Flat and round cables are used for redundancy. Flat cables have two connectors at one end. These two connectors connect to the adjacent controller slots. For the round cable version, two short cables are connected from the two adjacent controller slots to a special connection board. The third connector on this board is used to connect to the FlexTerm. This connector board also has a jumper between pins 7 and 8 to indicate to the controller that it is redundant.

It is important to note that a redundant flat cable cannot be used on a nonredundant controller for the upper connectors. Should a redundant flat cable be used on a nonredundant controller, the controller assumes it is redundant and clears out the configuration for the adjacent slot, because a redundancy indication for one controller is assumed for both.

If the controller processor loses RS-422 communications with the FIC, the redundant controller will take over. Note that this will happen any time an FIC is removed from the FlexTerm. Also, if an Instrument High or Low alarm is generated on a redundant controller pair, the redundant controller will take over, assuming that the A/D on the primary controller has failed. If the controller switchover was for one of these reasons, the alarm indication on the ControlFile Status Screen can be cleared by rebooting the redundant controller.

Instrument HIGH and LOW alarms must be configured before the redundant controllers will switchover in case of a controller A/D fault. Hardware alarms from the controllers are prioritized. If both controllers have active alarms, the controller with the lowest priority alarm will take over as primary controller.

SSC LEDs

The LEDs of all Controller Processor cards are essentially identical. See the LED description later in this section.

SSC Jumpers

The jumpers of all Controller Processor cards (except MPC II) are essentially identical. See the jumper description later in this section.

SSC Fuses

Figure 4.3.10 shows SSC fuse locations. Table 4.3.10 gives fuse data.

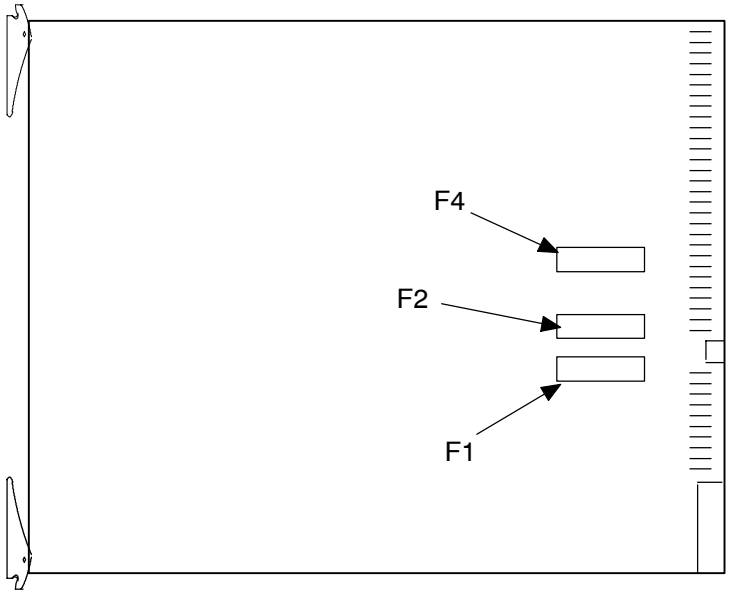


Figure 4.3.10. SSC Fuse Locations

Table 4.3.10. SSC Fuses

Card	Fuse	FRSI Part No.	Bussman Part No.	Littelfuse Part No.	Characteristics
1984-1371-000x 1984-1442-000x	F1 F2	G09140-0016	AGC 1/2	312.500	1/2 A 250 V Quick Acting
	F4	G09140-0041	MTH 5	312005	5 A 250V Regular

CC (Contact Controller Processor)

The Contact Controller Processor (CC) is superseded by the MultiPurpose (MPC) Controller Processor (1984-2500-000x). There are two CC models:

- 1984-1445-000x marked “CONTACT I/O PROCESSOR” on the PWA
- 1984-1374-000x marked “CONTACT PROCESSOR” on the PWA

Table 4.3.11 shows parts replacement data.

Table 4.3.11. Contact Controller Processor Parts Replacement

Part No.	Replaces	Characteristics
1984-2500-000x	1984-1445-000x	CONTACT PROCESSOR
1984-2500-000x	1984-1374-000x	CONTACT I/O PROCESSOR

The Contact Controller Processor has no analog circuitry, but it does have eight RS-422 communications ports communicating to two contact FICs in parallel. The Contact Processor can control two Contact FlexTerms, thus having a total of 96 contact modules with eight Contact FICs on each. Contact FICs monitor and control up to six optical isolator modules each. These modules can be AC or DC, in various voltage ranges.

NOTE: This card and image will only work with a standard I/O contact FlexTerm.

Communication: Communication with up to 16 Contact FICs is handled by the four dual port serial communication converters that transfer the parallel data from the data bus to serial RS-422 data.

Redundancy: The Contact Controller can be installed in any slot A through H. When a Contact Controller is used as a Redundant pair, only slots AB, CD, EF, and GH can be used as redundant pairs. Flat and round cables are used for redundancy. Flat cables have two connectors at one end. These two connectors attach to the adjacent controller slots. For the round cable version, two short cables are connected from the two adjacent controller slots to a special connection board. The third connector on this board is used to attach to the FlexTerm. This connector board also has a jumper between pins 7 and 8 to indicate to the controller that it is redundant.

It is important to note that a redundant flat cable cannot be used on a nonredundant controller for the upper connectors. Should a redundant flat cable be used on a nonredundant controller, the controller assumes it is redundant and clears out the configuration for the adjacent slot, because a redundancy indication for one controller is assumed for both.

If the controller processor loses RS-422 communications with the FIC, the redundant controller will take over. Note that this will happen any time an FIC is removed from the FlexTerm. The alarm indication on the ControlFile Status Screen can be cleared by rebooting the redundant controller. Hardware alarms from the controllers are prioritized. If both controllers have active alarms, the controller with the lowest priority alarm will take over as primary controller.

CC LEDs

The LEDs of all Controller Processor cards are essentially identical. See the LED description later in this section.

CC Fuse

Figure 4.3.11 shows the location of the fuse on the Contact Controller Processor. Table 4.3.12 gives fuse data.

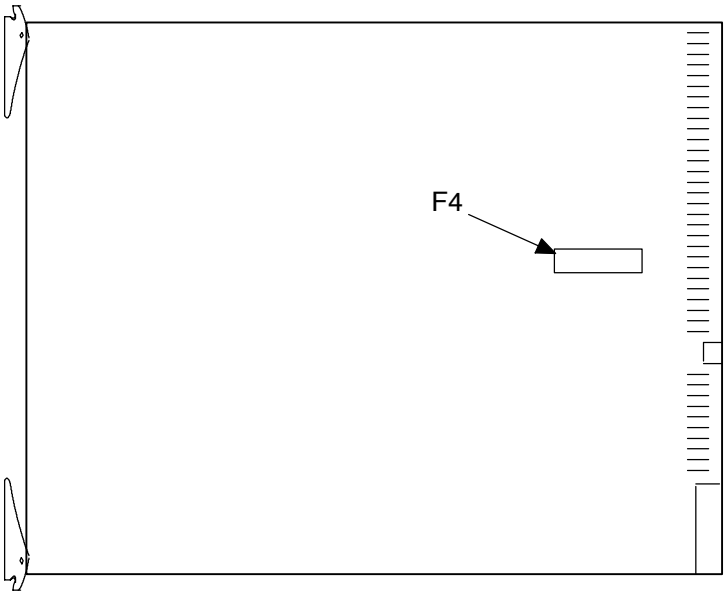


Figure 4.3.11. Contact Controller Processor Fuse Location

Table 4.3.12. Contact Controller Processor Fuse

Card	Fuse	FRSI Part No.	Bussman Part No.	Littelfuse Part No.	Characteristics
1984-1374-000x 1984-1445-000x	F4	G09140-0041	MTH 5	312005	5 A 250V Regular

MUX (Multiplexer Controller Processor)
PLC (Programmable Logic Controller Processor)

The Multiplexer Controller Processor (MUX) and the Programmable Logic Controller Processor (PLC) use the same card:

- 1984-1494-0001 marked “MULTIPLEXER PROCESSOR” on the PWA.

It is superseded by the MultiPurpose Controller Processor (MPC) (1984-2500-0005).

Table 4.3.13 shows parts replacement data.

Table 4.3.13. MUX and PLC Parts Replacement

Part No.	Replaces	Characteristics
1984-2500-0005	1984-1494-000x1	Multiplexer (MUX) or Programmable Logic Controller (PLC)

The card has two full duplex RS-422 communications ports and no analog circuitry.

MUX: As a MUX, the RS-422 ports are used to communicate with the Multiplexer FlexTerm. Each Multiplexer FlexTerm accommodates 100 inputs. An additional oscillator is used exclusively on the Multiplexer Processor to set up the 9600 Baud communication rate to the FlexTerm. The field inputs may be TCs, RTDs ,Voltage, and 4-20 mA. The Controller can scan all 100 inputs from the FlexTerm approximately once every 7 seconds.

PLC: As a PLC, the RS-422 ports are used to communicate with the PLC FlexTerm. The PLC FlexTerm changes the RS-422 protocol to RS-232. The FlexTerm can support RS-422 communications to the PLC bus as well. The PLC communicates at 9600 baud with the FlexTerm.

Redundancy: The MUX or PLC can be installed in any slot A through H. It cannot be made redundant either as a MUX or as a PLC.

MUX and PLC LEDs

The LEDs of all Controller Processor cards are essentially identical. See the LED description later in this section.

MUX and PLC Fuse

Figure 4.3.12 shows the location of the fuse on the card. Table 4.3.14 gives fuse data.

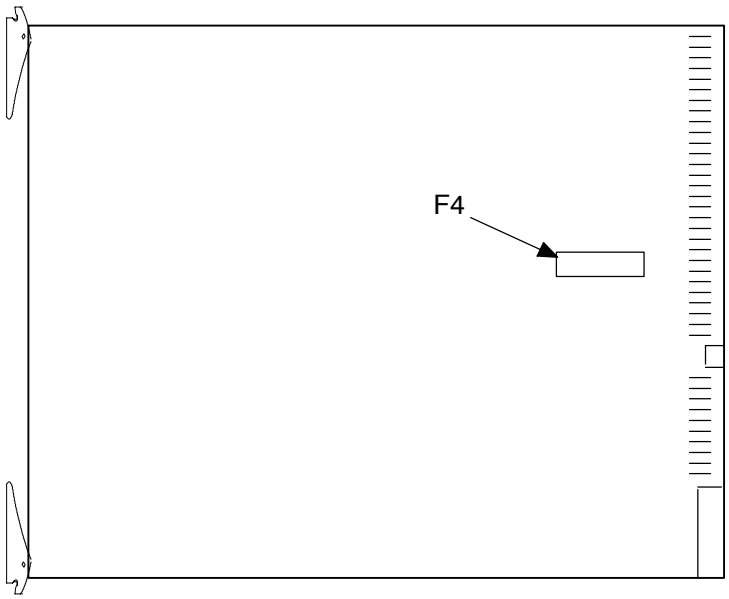


Figure 4.3.12. MUX and PLC Fuse Location

Table 4.3.14. MUX and PLC Fuse

Card	Fuse	FRSI Part No.	Bussman Part No.	Littelfuse Part No.	Characteristics
1984-1494-000x	F4	G09140-0041	MTH 5	312005	5 A 250V Regular

Controller Processor LEDs

The LED function of all Controller Processor cards is essentially identical. Some of the cards have two red LEDs at the top to indicate the condition of the + and – 12 volt fuses.

Controller Processor LED Sequence on Power Up

When the Controller Processor switch is placed in the ENABLE position, the Power Up Diagnostics sequence begins. In case of a failure of any of the tests, the sequence stops and begins again. The sequence stops at the fault indication. The red LED (card fault) will remain on, and the green LED will not come on at all. This process will continue until the controller is replaced or the test finally passes.

If the Controller Processor green LED (card enabled) lights and then goes out and the red LED comes back on, this indicates that the Controller Processor has passed the power-up diagnostics but the operating program has not been downloaded to the Coordinator Processor from the NV Memory. There may be a problem with the Coordinator Processor, NV Memory, configuration data, or else there may be no image present to be downloaded.

If the green and the yellow LEDs come on for about one second and then the diagnostic cycle starts again, the Controller Processor is waiting for the image from the Coordinator Processor. There may be a problem with the Coordinator Processor or the NV Memory.

If the alarm “Saved Configuration for Different Node” is generated, this indicates that the Controller Processor configuration image stored in the NV Memory is for a different node number and the Coordinator Processor will not allow the Controller Processor to start up with an incorrect image.

A “Wipe Bubble” or “Kill Controller” command must be used to clear the configuration from the NV Memory before the controller will operate. If you wish to start up the Controller Processor, it is first necessary to clear the NV Memory image by using the “Wipe Bubble” command. This is done on the command console screen by typing:

[W] [B] [=] [X] [Y] [ENTER]

(X=Node, and Y=controller slot).

Place the Controller Processor switch to DISABLE to clear the NV Memory. Place the Controller Processor switch to ENABLE to start properly with 100% free space.

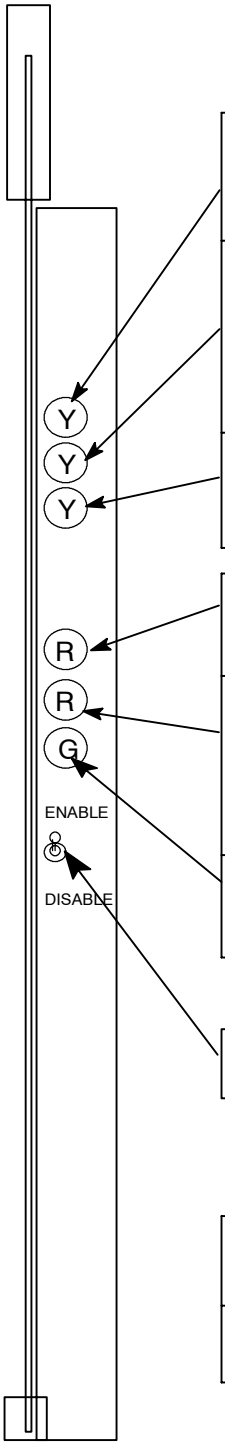
Table 4.3.15 shows the LED status for Controller Processor Faults.

Table 4.3.15. Controller Processor Fault Indications

Yellow LED Conditions	Fault Condition
OFF OFF **ON**	CPU Test Fault
OFF **ON** OFF	Boot ROM Checksum Fault
OFF **ON** **ON**	Vector Test Fault
ON OFF OFF	Watchdog Timer
ON OFF **ON**	Nondestructive RAM
ON **ON** OFF	Destructive RAM Test or EDAC Fault
ON **ON** **ON**	Sync Bus Test Levels 1 & 2 and Checks on Interrupts

MPC, CC, MUX, and PLC Controller Processor LEDs

Figure 4.3.13 shows the LEDs, Enable Disable Switch, and test points for the MultiPurpose, Contact, Multiplexer, and PLC Controller Processor cards.



LEDs

Block Evaluation (DS8)	The microprocessor is evaluating an input or output block. With redundant Contact Processors, this LED indicates which card is active.
CP Access (DS7)	The Coordinator Processor is accessing the Contact Processor's RAM memory and transferring configuration and dynamic data to the NV Memory. If the Contact Processor loses memory, current data is quickly reloaded from NV Memory.
Interrupt (DS6)	The Contact Processor is resetting its watchdog timer to prevent timing out or to acknowledge the synchronizing clock pulse.
5 V Fuse Blown (DS3)	Replace Fuse F4 (Supplies 5 VDC to the Contact Processor).
Card Fault (DS2)	A fault has been detected on the Contact Processor, or the ENABLE/DISABLE Switch is in the DISABLE position. If the switch is enabled and this LED is on, replace the Contact Processor.
Card Enable (DS1)	The ENABLE/DISABLE Switch is enabled and no hardware faults are detected on the Contact Processor.

ENABLE/DISABLE Switch

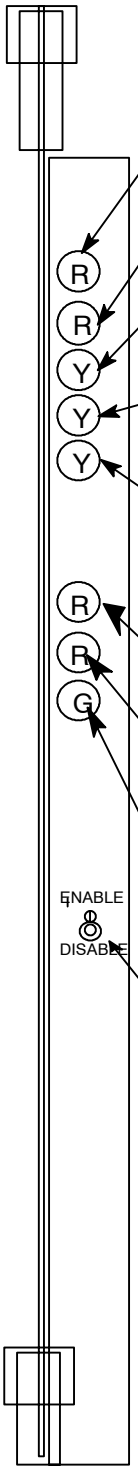
Test Points

Yellow	+5 V (± 0.1 V)
Brown	Ground Return

Figure 4.3.13. MPC, CC , MUX, and PLC Controller Processor LEDs and Test Points

MultiLoop and Single Strategy Controller Processor LEDs

Figure 4.3.14 shows LEDs, Enable/Disable switch, and test points for the MultiLoop and Single-Strategy Controller Processor cards.



LEDs

12 V Fuse Blown (DS10)	Replace Fuse F1 (supplies –12 VDC to the card).
+12 V Fuse Blown (DS9)	Replace Fuse F2 (supplies +12 VDC to the card).
Block Evaluation (DS8)	The microprocessor is evaluating an input or output block. With redundant MultiLoop processors, this LED indicates which one is active.
CP Access (DS7)	The Coordinator Processor is accessing the MultiLoop Processor RAM Memory and transferring configuration and dynamic data to the NV Memory. If the MultiLoop Processor loses memory, current data is quickly reloaded from Nonvolatile Memory.
Interrupt (DS6)	The MultiLoop Processor is resetting its watchdog timer either to prevent timing out or to acknowledge the synchronizing clock pulse.
5 V Fuse Blown (DS3)	Replace Fuse F4 (Supplies 5 VDC to the MultiLoop Processor).
Card Fault (DS2)	A fault has been detected on the MultiLoop Processor or the ENABLE/DISABLE Switch is in the disable position. If the switch is enabled and this LED is on, replace the MultiLoop Processor.
Card Enable (DS1)	The ENABLE/DISABLE Switch is enabled and no hardware faults are detected on the MultiLoop Processor.
ENABLE/DISABLE Switch	

Test Points

Yellow	5 V (± 0.1 V)
Red	12 V (± 0.1 V)
Brown	Ground Return

Figure 4.3.14. MultiLoop and Single-Strategy Controller Processor LEDs and Test Points

Controller Processor Enable/Disable Switch

The ENABLE/DISABLE switch can be used as follows during operation:

- If the switch is disabled on the primary card with a redundant backup present, the primary card goes out of service. The backup card takes over processing, at which time the primary card can be removed.

  NOTE: Before removing the primary CP card, first disable the Nonvolatile Memory card and the secondary CP card. For more information on removing and installing cards, see SV: 9-1.

- If the switch is disabled on a redundant backup, the backup ceases to perform background tests and tells the Coordinator Processor that it is out of service. It can return to backup status after it passes power-up diagnostic tests and data is downloaded from the NV Memory.
- If the switch is disabled on a primary card with no backup present, all communication between this Controller Processor and the Coordinator Processor halts. Any links from this Controller Processor to another Controller Processor will not be serviced. Processing resumes when the switch is returned to ENABLE, but only after the card passes power-up diagnostic tests and data is downloaded from the NV Memory. Failure on one Controller Processor does not affect other Controller Processors or PeerWay communications.

Controller Processor Jumpers

Each Controller Processor has jumpers to determine hardware and software functions. Most jumpers are hardwired and should not be adjusted. Other jumpers can be adjusted.

NOTE: MPCII and MPC5 jumpers differ from those used on the other Controller Processor cards. See pages 4-3-15 through 4-3-14 for more jumper information on MPCII and MPC5 cards.

A Controller Processor must have the correct software image to communicate with the desired I/O, or to utilize special software programs. Software images are downloaded from the NV memory to the MPC card. The Controller Processor card is jumpered to receive specific images. Figure 4.3.15 shows the locations of the software Image and communication rate jumpers. Table 4.3.16 and Table 4.3.17 show the jumper positions.

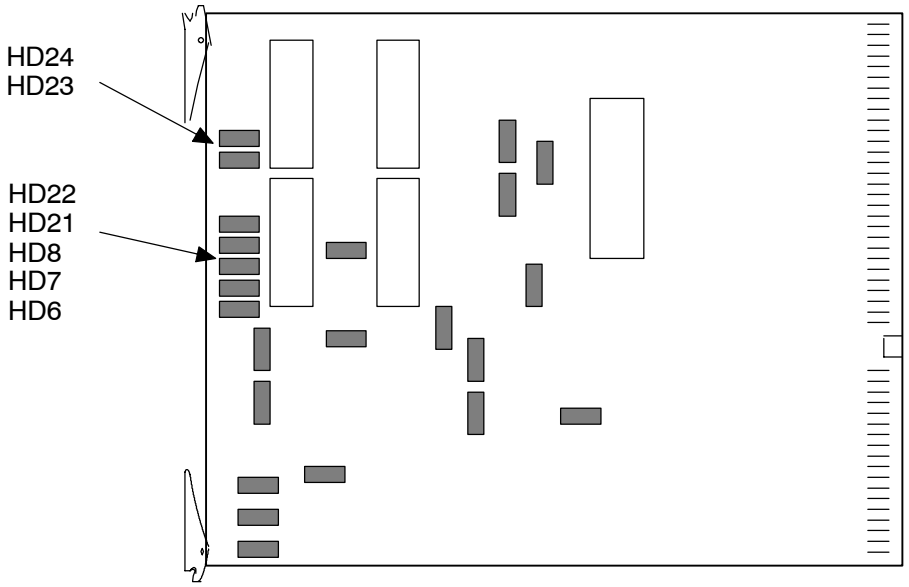


Figure 4.3.15. Controller Processor Software and Communication Rate Jumper Locations

Standard images are included with the $$CPxxxx Plant Program file. Additional images are loaded from the console into the CP separately from the $$CPxxxx file. The first file loaded into the CP after the $$CPxxxx file is called additional image 1. The second file loaded into the CP after the $$CPxxxx field is additional image 2, and so on. The number of additional images available for a CP depends on the system configuration.

The ControlFile Status screen shows the images loaded into a CP. The Jumper Code field is always blank for an MPCI or an MPCII operating as an MPCI.

Table 4.3.16. Image Jumper Positions (Not for MPC II or MPC5)

Image	Jumper HD6	Jumper HD7	Jumper HD8
Contact	2–3	2–3	1–2
Multiplexer	2–3	1–2	1–2
Additional Image #1	1–2	1–2	1–2
Additional Image #2	1–2	2–3	2–3
Additional Image #3	1–2	2–3	1–2
Additional Image #4	1–2	1–2	2–3

Table 4.3.17. Image Jumper Positions for MLC and SS

Image	Jumper HD6	Jumper HD7	Jumper HD8
MLC (MultiLoop Controller)	2–3	2–3	2–3
SS (Single Strategy)	2–3	2–3	2–3

NOTE: A Controller Processor must be set to the proper communications (Baud) rate for the I/O in use. Table 4.3.18 shows the jumper settings for 10.4K baud communications and for industry standard communications.

Table 4.3.18. Communications Jumper Positions (Not for MPC5)

Communication Rate	Jumper HD21	Jumper HD22	Jumper HD23	Jumper HD24
Fisher-Rosemount 10.4K Baud	2–3	2–3	2–3	2–3
Industry Standard (9600 Baud)	1–2	1–2	1–2	1–2

Controller Processor Redundancy

Controller Processors may be used in redundant pairs with one being the primary, and the other the backup. A controller switch causes the roles to reverse: the primary takes up the backup function and the backup takes on the primary function.

A controller switch can occur when:

- The user performs a manual switch from the ControlFile Status screen.
- The primary Controller Processor no longer communicates with the backup Controller Processor.
- The primary Controller Processor communicates with the backup Controller Processor but has a higher priority error condition than the backup Controller Processor. Controller Processor error conditions, in priority order, are:
  - ROM checksum error
  - A/D problems (MLC and SS only)
  - FIC communication channel failure
  - FIC communication error
  - NVRAM write error
  - RAM EDAC error (MPC and MPC II only)
  - Image error (MPC5 only)
  - Analog high/low alarms (MLC and SS only)

To prevent continuous Controller Processor switching, a mechanism limits switches to no more than three in a 5.5 minute period. Another mechanism limits switching due to consecutive instances of the same alarm. If a specific block alarm causes a controller switch, another instance of the same alarm during the next 10 seconds cannot cause another controller switch.

The use of redundant Controller Processors requires the use of an additional cable and the setting of jumpers on the Comm Connect card, Contact FlexTerms, and the comm termination panels.

NOTE: When a redundancy switch occurs with an MPC5 Controller Processor, the controller that was formerly primary will reboot and the Control File Status (CFS) screen will momentarily display the message "`Redun Cont Missing`" and a 1025 hardware alarm will be generated. This is an intentional change in system operation for the MPC5.

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Service Manual

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